APPENDIX

I. SUMMARY

A. INTRODUCTION

The members of the Secret Committee have undoubtedly spent many years learning quantum mechanics. They must have some conviction towards quantum mechanics; otherwise, they would recognize that quantum mechanics is a model—nothing more. Given that many very quantified physicists currently argue that quantum mechanics can not possibly represent reality,[1] it seems inappropriate for the Secret Committee to take the extreme position that a new discovery of lower-energy hydrogen must be dismissed out of hand since the definition of the ground state of the hydrogen atom posed in 1926 did not include such states.[2]

Many discoveries throughout history have been counter to theoretical expectations— recent examples include high-temperature superconductivity and the acceleration of the expansion of the universe.[3] Quantum mechanics is not strictly defined—it is a menagerie of theories which are not internally consistent or in agreement with directly testable physical laws. The only common theme is the equation $H\Psi = E\Psi$; yet, no one even has a straightforward universally agreed upon definition of what the parameter Ψ stands for. Perhaps due to vested interests, the Secret Committee has taken the position of defending quantum mechanics with very lopsided arguments regarding its successes without any consideration of its overwhelming shortcomings. This position is shared by other chemists:

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[1] References 32 and 60. The complete cite of each Reference is provided in the REFERENCES section below in Attachment B, which include Applicant's peer-reviewed publications that experimentally confirm lower-energy hydrogen technology of the claimed Invention.

[2] References 32 and 45.

[3] Reference 39 at Chapters 16 and 23.

Letter to the Editor of Chemical and Engineering News, May 7, 1990.[4]

Quantum theory

Sir: With regard to Richard C. Henry's review of the book, "The Tenth Dimension" (C&EN, Jan 22, page 27), I, for one, am tired of being bullied by physicist bearing the red herring of quantum theory—a failed theory if there ever was one. As was remarked by more than one chemist in these pages over the past two or three decades, literally man-centuries of work have been wasted trying to synthesize compounds that the quantum theory unequivocally states should be stable, only to find that the compounds do not exist in any form whatsoever.

Of course, the physics community itself is deeply divided over the validity of the Schrödinger equation with about half (as best I can judge) not believing that the equation is a correct, let alone a complete, representation of reality. Einstein was only the most famous of the physicists who dissented from the Schrödinger formulation—there are and were hordes of others, Louis de Broglie fought the theory through all the days of his life, though his famous equation was an integral part of its development.

As things have gone on through the years, the results have been an ever more bizarre progression of ideas and assertions that have finally culminated in what is simply solipsistic nihilism—"nothing can exist except what I want to exist"—as grotesque as it is absurd. The next time you watch your TV screen, just imagine that it isn't being lighted up by accelerated electrons at all, just by your own desire.

There is nothing at all wrong with the idea of an electron orbiting around a proton—this is exactly what Bohr used to develop his original ideas, in very close agreement with experiment, and based on the redoubtable Coulomb's law. Aside from leading to all sorts of impossible conundrums and paradoxes, Schrödinger's equation does not—repeat not—predict all four quantum numbers (it misses spin altogether), and succeeds in only a few very special cases in predicting anything at all that can be subject to precise measurement. For these and many other reasons (including the destruction of the very logic of science itself), I repeat that legions of physicists have rejected the Schrödinger quantum formulation, believing at best that the correct and complete theory has yet to be worked out. (Score: a few select successes, and mountains of failures. Sensible theoretical chemists continue to shun quantum theory in droves.)

It is a shame that the educational experiences of most chemists do not

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[4] Copy of letter in filed herewith Information Disclosure Statement.

permit them to evaluate, let alone see through, this welter of nonsense and confusion, and thus to send the infamous thing (quantum theory) back to its makers with an appropriate what on its bedraggled tail. You can see the result of this hodgepodge in any introductory chemistry text that you care to open. (Pace Voltaire!)

Although history cannot be altered, future curricula can be adjusted to help prevent another similar fiasco from occurring—or at least try.

Allan Weinstein
Lawrence, Kan.

The purpose of the U.S. Patent Office is not to join the fray of the unresolved 100-year-old debate about the validity of quantum mechanics which gained notoriety with the infamous debate between Bohr and Einstein.[5] There is no question that quantum mechanics possesses severe shortcomings that can not be dismissed by wishing it so or quoting aficionados. Many great physicists rejected Quantum Mechanics. Feynman also attempted to use first principles including Maxwell's Equations to discover new physics to replace quantum mechanics.[6] Other great physicists of the 20th century searched for other theories. "Einstein ... insisted ... that a more detailed, wholly deterministic theory must underlie the vagaries of quantum mechanics."[7]

For example, the Secret Committee cites Wheeler regarding his position that we have to accept the weirdness of quantum mechanics—the same Wheeler who espouses "parallel mind universes" as the meaning of reality according to quantum mechanics.[8] As discussed by Applicant,[9] actually we do not have to accept the weirdness of quantum mechanics wherein only weird, inconsistent, and counter-intuitive interpretations of data defying known physical laws such as special relativity, Maxwell's equation, conservation of energy and momentum, and

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[5] The recent experiments by Durr et al. demonstrate that Bohr was wrong and Einstein was right as discussed in Reference 32. See also References 45 and 39 at Chapter 37, The Wave-Particle Duality is Not Due to the Uncertainty Principle.

[6] Reference 52.

[7] Reference 53.

[8] Reference 53.

[9] Reference 32, 45 and 39 at Forward section and Chapter 37.

causality are taken as reality. The physical world can be explained up to 11-figure accuracy in closed form equations derived from directly testable physical laws.

[Note – this is predictive, in contrast, Quantum is not predictive and is continuously adjusting the formulae to match new contradictive experimental results!]

Theories are merely models of reality, they are not a substitute for reality. Quantum mechanics gives predictions that do not agree with experimentation even for the one electron atom. At least 18 discrepancies exist between the predictions of quantum mechanics and observation.[10] Applicant has developed a model based on Maxwell's equations to guide his research. Since it is *based on directly testable and proven physical laws*, this is a more valid approach than quantum mechanics—even one that Feynman attempted.[11]

Applicant's Classical Quantum Mechanics is remarkably accurate and unprecedented at predicting observed phenomenon over a scale of 85 orders of magnitude.[12] New compounds were predicted by Applicant that were disclosed in applications starting in 1997. The role of the PTO is examine the data which supports Applicant's claims—new chemical compounds in this case. It will be demonstrated that Applicant has met his burden of proof of novel compositions of matter comprising lower-energy hydrogen. The theoretical calculations presented stand on their own merit in that they match the observed data. Pointing out the misdirection of quantum mechanics which spawned a 100-year debate regarding the philosophy of reality initiated by the founders of quantum mechanics, such as Bohr, Schrodinger, Einstein, de Broglie, and Dirac, should not be the focus of the prosecution of Applicant's case, and Applicant should not be prejudiced by the Secret Committee's blind bias in that regard.[13]

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[10] References 32 and 45.

[11] Reference 52.

[12] Reference 39 at Forward Section.

[13] Reference 32.

B. Applicant's Position that the Basis of Lower-Energy atomic Hydrogen Has Theoretical Merit and is Demonstrated Experimentally

a. Catalysis Reaction to Form Hydrinos

J. R. Rydberg showed that all of the spectral lines of atomic hydrogen were given by a completely empirical relationship:

$$\overline{v} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right) \tag{1}$$

where $R = 109,677 \ cm^{-1}$, $n_f = 1, 2, 3, ...$, $n_i = 2, 3, 4, ...$ and $n_i > n_f$. Bohr, Schrodinger, and Heisenberg each developed a theory for atomic hydrogen that gave the energy levels in agreement with Rydberg's equation.

$$E_n = -\frac{e^2}{n^2 8\pi\varepsilon_o a_H} = -\frac{13.598 \ eV}{n^2} \tag{2a}$$

$$n = 1, 2, 3, ... \tag{2b}$$

The excited energy states of atomic hydrogen are given by Eq. (2a) for $n > 1$ in Eq. (2b). The $n = 1$ state is the "ground" state for "pure" photon transitions (i.e. the $n = 1$ state can absorb a photon and go to an excited electronic state, but it cannot release a photon and go to a lower-energy electronic state). However, an electron transition from the ground state to a lower-energy state may be possible by a resonant nonradiative energy transfer such as multipole coupling or a resonant collision mechanism. Processes such as hydrogen molecular bond formation that occur without photons and that require collisions are common.[14] Also, some commercial phosphors are based on resonant nonradiative energy transfer involving multipole coupling.[15]

Applicant proposes that atomic hydrogen may undergo a catalytic reaction with certain atoms and ions such as He^+ which singly or multiply ionize at integer multiples of the potential energy of atomic hydrogen, $m \cdot 27.2 \ eV$ wherein m is an integer. The theory was given previously.[16] The reaction involves a nonradiative energy transfer to form a hydrogen atom that is lower in energy than unreacted atomic hydrogen that corresponds to a fractional principal quantum number. That is

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[14] Reference 61 at page 17.

[15] Reference 62 at page 68.

[16] Reference Nos. 27, 28, 32, 39, and 45.

$$n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, ..., \frac{1}{p}; \quad p \text{ is an integer} \tag{2c}$$

replaces the well known parameter $n = $ integer in the Rydberg equation for hydrogen excited states. The $n = 1$ state of hydrogen and the $n = \dfrac{1}{\text{integer}}$ states of hydrogen are nonradiative, but a transition between two nonradiative states is possible via a nonradiative energy transfer, say $n = 1$ to $n = 1/2$. Thus, a catalyst provides a net positive enthalpy of reaction of $m \cdot 27.2 \, eV$ (i.e. it resonantly accepts the nonradiative energy transfer from hydrogen atoms and releases the energy to the surroundings to affect electronic transitions to fractional quantum energy levels). As a consequence of the nonradiative energy transfer, the hydrogen atom becomes unstable and emits further energy until it achieves a lower-energy nonradiative state having a principal energy level given by Eqs. (2a) and (2c).

b. Lower-Energy Hydrogen Experimental Data

Analytical studies that experimentally confirm the novel reaction of atomic hydrogen, which produces hydrogen in fractional quantum states that are at lower energies than the traditional "ground" ($n = 1$) state, a chemically generated or assisted plasma (rt-plasma), and produces novel hydrino hydride compounds, include:

extreme ultraviolet (EUV) spectroscopy,[17]

characteristic emission from catalysis and the hydride ion products,[18]

lower-energy hydrogen emission,[19]

plasma formation,[20]

Balmer α line broadening,[21]

elevated electron temperature,[22]

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[17] References 1, 2, 12-18, 20-22, 25, 29, 33-35, 37, and 38.

[18] References 7, 10, 11, 17, 22, and 25.

[19] References 13-16, 20, and 21.

[20] References 1, 2, 7, 10, 17, 22, 25, 29, 33, 34, and 36-38.

[21] References 2, 5, 7, 10, 12-16, 19, and 29.

[22] References 2, 5, and 12-15.

anomalous plasma afterglow duration,[23]

power generation,[24] and

analysis of chemical compounds.[25]

One skilled in the art would readily understand and be able to reproduce these analytical studies. The following 41 numbered paragraphs briefly describe real-world, reproducible analytical studies of Applicant's lower-energy hydrogen technology, all of which are of record in the subject application and should have been fully considered by the Secret Committee:

1.) the observation of intense extreme ultraviolet (EUV) emission at low temperatures (e.g. $\approx 10^3 \ K$) from atomic hydrogen and only those atomized elements or gaseous ions which provide a net enthalpy of reaction of approximately $m \cdot 27.2 \ eV$ via the ionization of t electrons to a continuum energy level where t and m are each an integer (e.g. K, Cs, and Sr atoms and Rb^+ ion ionize at integer multiples of the potential energy of atomic hydrogen and caused emission; whereas, the chemically similar atoms, Na, Mg, and Ba, do not ionize at integer multiples of the potential energy of atomic hydrogen and caused no emission),[26]

2.) the observation of novel EUV emission lines from microwave and glow discharges of helium with 2% hydrogen with energies of $q \cdot 13.6 \ eV$ where $q = 1,2,3,4,6,7,8,9,11,12$ or these lines inelastically scattered by helium atoms in the excitation of $He \ (1s^2)$ to $He \ (1s^1 2p^1)$ that were identified as hydrogen transitions to electronic energy levels below the "ground" state corresponding to fractional quantum numbers,[27]

3.) the observation of novel EUV emission lines from microwave and glow discharges of helium with 2% hydrogen at 44.2 nm and 40.5 nm with energies of

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[23] References 1 and 36-37.

[24] References 5, 10, 14-16, 18, 19, 24, 26, and 46-48.

[25] References 3, 4, 11, 24, 30, and 40-44.

[26] References 1, 2, 7, 10, 17, 22, 25, 29, 33, 34, and 36-38.

[27] References 13-16, and 21.

$$q \cdot 13.6 + \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right) X13.6 \, eV$$ where $q = 2$ and $n_f = 2,4$ $n_i = \infty$ that corresponded to

multipole coupling to give two photon emission from a continuum excited state atom and an atom undergoing fractional Rydberg state transition,[28]

4.) the identification of transitions of atomic hydrogen to lower energy levels corresponding to lower-energy hydrogen atoms in the extreme ultraviolet emission spectrum from interstellar medium and the sun,[29]

5.) the EUV spectroscopic observation of lines by the Institut fur Niedertemperatur-Plasmaphysik e.V. that could be assigned to transitions of atomic hydrogen to lower energy levels corresponding to fractional principal quantum numbers and the emission from the excitation of the corresponding hydride ions,[30]

6.) the recent analysis of mobility and spectroscopy data of individual electrons in liquid helium which shows direct experimental confirmation that electrons may have fractional principal quantum energy levels,[31]

7.) the observation of novel EUV emission lines from microwave discharges of argon or helium with 10% hydrogen that matched those predicted for vibrational transitions of $H_2^*[n = 1/4; n^* = 2]^+$ with energies of $\upsilon \cdot 1.185 \, eV$, $\upsilon = 17 \, to \, 38$ that terminated at the predicted dissociation limit, E_D, of $H_2[n = 1/4]^+$, $E_D = 42.88 \, eV \, (28.92 \, nm)$,[32]

8.) the observation of continuum state emission of Cs^{2+} and Ar^{2+} at $53.3 \, nm$ and $45.6 \, nm$, respectively, with the absence of the other corresponding Rydberg series of lines from these species which confirmed the resonant nonradiative energy transfer of $27.2 \, eV$ from atomic

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[28] Reference 13.

[29] Reference 20, 21, 32, 45.

[30] Reference 35.

[31] Reference 32.

[32] Reference 20.

hydrogen to the catalysts atomic Cs or Ar^+,[33]

9.) the spectroscopic observation of the predicted hydride ion $H^-(1/2)$ of hydrogen catalysis by either Cs atom or Ar^+ catalyst at 407 nm corresponding to its predicted binding energy of 3.05 eV,[34]

10.) the observation of characteristic emission from K^{3+} which confirmed the resonant nonradiative energy transfer of $3 \cdot 27.2$ eV from atomic hydrogen to atomic K,[35]

11.) the spectroscopic observation of the predicted $H^-(1/4)$ ion of hydrogen catalysis by K catalyst at 110 nm corresponding to its predicted binding energy of 11.2 eV,[36]

12.) the observation of characteristic emission from Rb^{2+} which confirmed the resonant nonradiative energy transfer of 27.2 eV from atomic hydrogen to Rb^+,[37]

13.) the spectroscopic observation of the predicted $H^-(1/2)$ ion of hydrogen catalysis by Rb^+ catalyst at 407 nm corresponding to its predicted binding energy of 3.05 eV,[38]

14.) the high resolution visible spectroscopic observation from rt-plasmas and plasma electrolysis cells of the predicted $H^-(1/2)$ ion of hydrogen catalysis by each of K^+/K^+, Rb^+, Cs, and Ar^+ at 407 nm corresponding to its predicted binding energy of 3.05 eV,[39]

15.) the observation of $H^-(1/2)$, the hydride ion catalyst product of K^+/K^+ or Rb^+, by high resolution visible spectroscopy as a broad peak at 407.00 nm with a FWHM of 0.14 nm

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[33] Reference 25.

[34] Reference 25.

[35] Reference 22.

[36] Reference 7 and 22.

[37] Reference 17.

[38] Reference 17.

[39] Reference 2, 7, 10, 11, 17, 22, and 25.

corresponding to its predicted binding energy of 3.0468 eV,[40]

16.) the observation that the high resolution visible plasma emission spectra in the region of 400.0 nm to 406.0 nm matched the predicted bound-free hyperfine structure lines E_{HF} of $H^-(1/2)$ calculated from the electron g factor as $E_{HF} = j^2 3.0056 \, X \, 10^{-5} + 3.0575 \, eV$ (j is an integer) for $j = 1$ to $j = 37$ to within a 1 part per 10^5,[41]

17.) Rb^+ or $2K^+$ catalysts formed a plasma having strong VUV emission with a stationary inverted Lyman population and emission from $H^-(1/2)$ was observed at 4070.0 Å corresponding to its predicted binding energy of 3.0468 eV with its predicted bound-free hyperfine structure lines $E_{HF} = j^2 3.0056 \, X \, 10^{-5} + 3.0575 \, eV$ (j is an integer) that matched for $j = 1$ to $j = 37$ to within a 1 part per 10^5,[42]

18.) the observation by the Institut fur Niedertemperatur-Plasmaphysik e.V. of an anomalous plasma and plasma afterglow duration formed with hydrogen-potassium mixtures,[43]

19.) the observation of anomalous afterglow durations of plasmas formed by catalysts providing a net enthalpy of reaction within thermal energies of $m \cdot 27.28 \, eV$,[44]

20.) the observation of Lyman series in the EUV that represents an energy release about 10 times that of hydrogen combustion which is greater than that of any possible known chemical reaction [Reference 1, 2, 7, 10, 17, 22, 25, 29, 33, 34, and 36-38],

21.) the observation of line emission by the Institut fur Niedertemperatur-Plasmaphysik e.V. with a 4° grazing incidence EUV spectrometer that was 100 times more energetic than the combustion of hydrogen,[45]

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[40] Reference 2 and 7.

[41] Reference 2 and 7.

[42] Reference 2.

[43] References 1 and 36.

[44] References 1 and 36-37.

[45] Reference 35.

22.) the observation of anomalous plasmas formed with Sr and Ar^+ catalysts at 1% of the theoretical or prior known voltage requirement with a light output per unit power input up to 8600 times that of the control standard light source,[46]

23.) the observation that the optically measured output power of gas cells for power supplied to the glow discharge increased by over two orders of magnitude depending on the presence of less than 1% partial pressure of certain catalysts in hydrogen gas or argon-hydrogen gas mixtures, and an excess thermal balance of 42 W was measured for the 97% argon and 3% hydrogen mixture versus argon plasma alone,[47]

24.) the observation that glow discharge plasmas of the catalyst-hydrogen mixtures of strontium-hydrogen, helium-hydrogen, argon-hydrogen, strontium-helium-hydrogen, and strontium-argon-hydrogen showed significant Balmer α line broadening corresponding to an average hydrogen atom temperature of 25 - 45 eV; whereas, plasmas of the noncatalyst-hydrogen mixtures of pure hydrogen, krypton-hydrogen, xenon-hydrogen, and magnesium-hydrogen showed no excessive broadening corresponding to an average hydrogen atom temperature of $\approx 3\ eV$,[48]

25.) the observation that microwave helium-hydrogen and argon-hydrogen plasmas having catalyst Ar^+ or He^+ showed extraordinary Balmer α line broadening due to hydrogen catalysis corresponding to an average hydrogen atom temperature of 110-130 eV and 180-210 eV, respectively; whereas, plasmas of pure hydrogen, neon-hydrogen, krypton-hydrogen, and xenon-hydrogen showed no excessive broadening corresponding to an average hydrogen atom temperature of $\approx 3\ eV$,[49]

26.) the observation that microwave helium-hydrogen and argon-hydrogen plasmas

[46] Reference 26, 29, 33 and 38.

[47] Reference 26.

[48] Reference 19, 29 and 33.

[49] Reference 12 and 13.

showed average electron temperatures that were high, 28,000 K and 11,600 K, respectively; whereas, the corresponding temperatures of helium and argon alone were only 6800 K and 4800 K, respectively,[50]

27.) the observation of significant Balmer α line broadening of 17, 9, 11, 14, *and* 24 *eV* from rt-plasmas of incandescently heated hydrogen with K^+ / K^+, Rb^+, cesium, strontium, and strontium with Ar^+ catalysts, respectively, wherein the results could not be explained by Stark or thermal broadening or electric field acceleration of charged species since the measured field of the incandescent heater was extremely weak, 1 V/cm, corresponding to a broadening of much less than 1 *eV*,[51]

28.) calorimetric measurement of excess power of 20 mW/cc on rt-plasmas formed by heating hydrogen with K^+ / K^+ and Ar^+ as catalysts,[52]

29.) the Calvet calorimetry measurement of an energy balance of over $-151,000 \ kJ / mole \ H_2$ with the addition of 3% hydrogen to a plasma of argon having the catalyst Ar^+ compared to the enthalpy of combustion of hydrogen of $-241.8 \ kJ / mole \ H_2$; whereas, under identical conditions no change in the Calvet voltage was observed when hydrogen was added to a plasma of noncatalyst xenon,[53]

30.) the observation that the power output exceeded the power supplied to a hydrogen glow discharge plasmas by 35-184 W depending on the presence of catalysts from helium or argon and less than 1% partial pressure of strontium metal in noble gas-hydrogen mixtures; whereas, the chemically similar noncatalyst krypton had no effect on the power balance,[54]

31.) the observation that with the addition of 3% flowing hydrogen to an argon

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[50] Reference 12, 13 and 15.

[51] Reference 10.

[52] Reference 10.

[53] Reference 18.

[54] Reference 19.

microwave plasma with an constant input power of 40 W, the gas temperature increased from 400°C to over 750°C; whereas, the 400°C temperature of a xenon plasma run under identical conditions was essentially unchanged with the addition of hydrogen,[55]

32.) the observation that upon the addition of 10% hydrogen to a helium microwave plasma maintained with a constant microwave input power of 40 W, the thermal output power was measured to be at least 400 W corresponding to a reactor temperature rise from room temperature to 1200 °C within 150 seconds, a power density of 40 MW/m^3, and an energy balance of at least -5×10^5 $kJ/mole \, H_2$ compared to the enthalpy of combustion of hydrogen of $-241.8 \, kJ/mole \, H_2$,[56]

33.) the differential scanning calorimetry (DSC) measurement of minimum heats of formation of KHI by the catalytic reaction of K with atomic hydrogen and KI that were over $-2000 \, kJ/mole \, H_2$ compared to the enthalpy of combustion of hydrogen of $-241.8 \, kJ/mole \, H_2$[57],

34.) the isolation of novel hydrogen compounds as products of the reaction of atomic hydrogen with atoms and ions which formed an anomalous plasma as reported in the EUV studies,[58]

35.) the identification of a novel highly stable surface coating $SiH(1/p)$ by time of flight secondary ion mass spectroscopy that showed SiH^+ in the positive spectrum and H^- dominant in the negative spectrum and by X-ray photoelectron spectroscopy which showed that the H content of the SiH coatings was hydride ions, $H^-(1/4)$, $H^-(1/9)$, and $H^-(1/11)$ corresponding to peaks at 11, 43, and 55 eV, respectively, and showed that the surface was remarkably stable to air,[59]

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[55] Reference 5.

[56] Reference 13.

[57] Reference 24.

[58] Reference 3, 4, 11, 24, 30, and 40-44.

[59] Reference 3.

36.) the isolation of novel inorganic hydride compounds such as $KH KHCO_3$ and KH following each of the electrolysis and plasma electrolysis of a K_2CO_3 electrolyte which comprised high binding energy hydride ions that were stable in water with their identification by methods such as (i) ToF-SIMS on $KH KHCO_3$ which showed inorganic hydride clusters $K[KH KHCO_3]_n^+$ and a negative ToF-SIMS dominated by hydride ion, (ii) X-ray photoelectron spectroscopy which showed novel peaks corresponding to high binding energy hydride ions, and (iii) proton nuclear magnetic resonance spectroscopy which showed upfield shifted peaks corresponding to more diamagnetic, high-binding-energy hydride ions,[60]

37.) the identification of $LiHCl$ comprising a high binding energy hydride ion by time of flight secondary ion mass spectroscopy which showed a dominant H^- in the negative ion spectrum, X-ray photoelectron spectroscopy which showed $H^-(1/4)$ as a new peak at its predicted binding energy of 11 eV, ^1H nuclear magnetic resonance spectroscopy which showed an extraordinary upfield shifted peak of 15.4 ppm corresponding to the novel hydride ion, and powder X-ray diffraction which showed novel peaks,[61]

38.) the identification of novel hydride compounds by a number of analytic methods as such as (i) time of flight secondary ion mass spectroscopy which showed a dominant hydride ion in the negative ion spectrum, (ii) X-ray photoelectron spectroscopy which showed novel hydride peaks and significant shifts of the core levels of the primary elements bound to the novel hydride ions, (iii) ^1H nuclear magnetic resonance spectroscopy (NMR) which showed extraordinary upfield chemical shifts compared to the NMR of the corresponding ordinary hydrides, and iv.) thermal decomposition with analysis by gas chromatography, and mass spectroscopy which identified the compounds as hydrides,[62]

39.) the NMR identification of novel hydride compounds MH^*X wherein M is the alkali or alkaline earth metal, X, is a halide, and H^* comprises a novel high binding energy

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[60] Reference 8, 11, 41, 43, and 44.

[61] Reference 4.

[62] Reference 8, 11, 41, and 43.

hydride ion identified by a large distinct upfield resonance,[63]

40.) the replication of the NMR results of the identification of novel hydride compounds by large distinct upfield resonances at Spectral Data Services, University of Massachusetts Amherst, University of Delaware, Grace Davison, and National Research Council of Canada,[64] and

41.) the NMR identification of novel hydride compounds MH^* and MH_2^* wherein M is the alkali or alkaline earth metal and H^* comprises a novel high binding energy hydride ion identified by a large distinct upfield resonance that proves the hydride ion is different from the hydride ion of the corresponding known compound of the same composition.[65]

42.) the NMR, TOF-SIMS, XPS identification of novel hydrino hydride compounds and analysis of chemically-produced plasma by an expert hired by the Liebert Corporation, a division of the well-known and highly-respected Emerson Corporation. According to the expert's own words, he "observed demonstrations of the BlackLight Power (BLP) process and . . . reached the inescapable conclusion that it is based on extraordinary chemical reactions that seem to release extraordinary amounts of energy. . . . It is [his] professional opinion that the BLP process represents a chemical conversion of atomic hydrogen unlike any previously reported [in] the archival scientific literature." Although the expert states that he was skeptical of Applicant's theory, he admitted that the chemical and plasma data did support Applicant's fractional quantum states and that he could offer no other explanation of the data using conventional quantum theory.[66]

Applicant submits that the Secret Committee has unfairly ignored the vast majority of this experimental evidence, since it does not comply with its views of Quantum Theory. The

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[63] Reference 4, 24, 30, 40, and 42.

[64] Reference 30.

[65] Reference 30.

[66] Reference 84.

Committee even goes so far as to misrepresent the record by stating that "applicant's theory is the *unique* source from which the existence of the "hydrino atom" is demonstrated." [page 5, second to last paragraph in the Attachment to the Final Office Action] This simply is not true. Applicant has maintained that the hydrino atom is fully supported by the experimental data of record, including the spectral lines that conclusively show these lower-energy states.

1. Applicant's response to the Secret Committee's "Introduction" in the Final Office Action

Applicant has provided a theory to further explain his invention -- even though there is no requirement that he do so -- which along with Applicant's supporting test data, has been peer-reviewed and published in the prestigious *International Journal of Hydrogen Energy*.

Applicant chose to submit his experimental data for publication in the *International Journal of Hydrogen Energy* since its subject matter most closely relates to Applicant's lower-energy hydrogen technology. The Journal did not merely publish what Applicant submitted. Rather, the Editor sent out Applicant's submissions to top PhD experts in the field. The PhD scientists peer-reviewing Applicant's papers were exhaustive in their research, requiring Applicant to conduct further extensive analyses, experimental controls, and additional experiments to further confirm the reported results and conclusions.

Applicant has shown that lower-energy hydrogen atoms are equally valid solutions to the "current state of the art atomic theory".[67] Applicant finds it quite shocking that the PTO continues to circle around the true patentability questions, such as whether the experimental test data of record supports lower-energy hydrogen, and instead attempts to discredit Applicant's technology by implication to unproven technologies such as cold fusion. Applicant considers this behavior as harassment.

Over ten years ago, the PTO rejected Applicant's technology by implication, as

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[67] Reference 32.

improperly relating to cold fusion and then dropped those cold fusion rejections in the latest Office Actions. The PTO again raised cold fusion claims as a basis for withdrawing the present application from issuance, and then again dropped those claims when forced to provide support in front of the U.S. District Court, tacitly admitting that Applicant's technology does not relate to cold fusion. No cold fusion claims were made by the PTO in the first Office Action issued after the withdrawal in the present application. Shockingly, the PTO once again raises cold fusion claims, in a **final** Office Action no less. There simply can be no other motive for the PTO to follow this behavior, other than subversion of Applicant's technology at all costs.

Nonetheless, Applicant will once again respond to the improper cold fusion allegations made by the PTO throughout the pending Office Action. Over ten years ago, Applicant presented a reasonable prediction that muon-like catalyzed fusion, <u>not cold fusion</u>, may be possible, which requires testing and which is **not** claimed in the present application. Applicant reminds the PTO that the present claims relate to compositions of matter which are supported by analytical test data. Thus, a prediction made a decade ago has no bearing on the prosecution of the presently claimed invention and should be dropped, as it was many times during the sordid prosecution of Applicant's technology.

In R. Mills, The Grand Unified Theory of Classical Quantum Mechanics, September 2001 Edition at p. 217 appears:

Hydrino Catalyzed Fusion (HCF)
The electric field of a hydrogen atom is zero for $r > r_n$, where r_n is the radius of the orbitsphere of the electron (See Figure 1.9). Thus, as the orbitsphere shrinks with transitions to lower-energy states, approaching nuclei achieve a smaller internuclear distance (between two deuterium or tritium atoms, for example) corresponding to a smaller electric barrier compared to $n = 1$ state atoms. As the internuclear separation decreases, fusion is more probable. In muon catalyzed fusion,[68] for example, the internuclear separation is reduced by about 200 (the muon to electron mass ratio) and the fusion rate increases by about 80 orders of magnitude. Once a deuterium hydrino atom is

[68] References 63 and 64.

formed by a catalyst, further catalytic transitions $n = \frac{1}{2} \rightarrow \frac{1}{3}, \frac{1}{3} \rightarrow \frac{1}{4}, \frac{1}{4} \rightarrow \frac{1}{5}$, and so on may occur to a substantial extent. This is consistent with the previously reported series of lower-energy hydrogen lines with energies of $q \cdot 13.6 \, eV$ where $q = 1,2,3,4,6,7,8,9,11,12$.[69] The radius and the internuclear separation can be reduced to 1/137 that formed from the $n = 1$ state atoms (Eqs. (5.75) and (12.2)). This muon catalyzed fusion-like process which may yield detectable rates is called Hydrino Catalyzed Fusion (HCF).

It is important to note that tritium, ^{3}H, and protons, ^{1}H, may dominate the products of HCF. In conventional high temperature fusion such as that of the Sun and magnetic confinement, deuterium nuclei collide randomly and produce about 50% ^{3}H plus ^{1}H and about 50% ^{3}He plus a neutron. In HCF, however, the nuclei are moving slowly and will collide in the most favored coulombic arrangement—with the two protons as far from each other as possible. Thus, for HCF, more ^{3}H is predicted to be produced than ^{3}He.

Cold Fusion according to Pons and Fleishmann and followers cited by the PTO is **not** disclosed, endorsed, or claimed by Applicant, and the PTO is well aware of this. More particularly, no fusion by compression of hydrogen isotopes in metal lattices is disclosed, supported, or claimed. The reference that Applicant made *a decade ago* to the reported phenomenon of "Cold Fusion" regarded the necessity to consider novel chemical reactions in electrolysis experiments is further discussed in Sections 11 and 12 of this Response.

2. Applicant's response to the "Secret Committee's position and state-of-the-art recognition of the validity of quantum mechanics"

Applicant' position is that state-of-the-art quantum mechanics is a probability wave theory, which is **not** a valid model of reality, nor does it represent reality—a position that was shared by the founders of quantum mechanics such as Schrodinger, de Broglie, Einstein, and Dirac. Other notable theoreticians pointed out serious flaws such as Weisskopf and Klein.[70] Recently, Laloë has reviewed the confusion which is quantum mechanics.[71] Thus, it is absolutely absurd for the PTO to rely on a theory, which is known not to represent reality, and

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[69] References 7 and 21.

[70] References 32, 45 and 39 at Forward and Introduction sections and Chapters 35-38.

[71] Reference 60.

use it reject real-world experimental evidence.

This point has already been made to the PTO and is addressed fully in the Forward section of R. Mills, The Grand Unified Theory of Classical Quantum Mechanics, September 2001 Edition, which states:

QUANTUM THEORY PAST AND FUTURE

The Schrodinger equation was originally postulated in 1926 as having a solution of the one electron atom. It gives the principal energy levels of the hydrogen atom as eigenvalues of eigenfunction solutions of the Laguerre differential equation. But, as the principal quantum number $n \gg 1$, the eigenfunctions become nonsensical. Despite its wide acceptance, on deeper inspection, the Schrodinger solution is plagued with many failings as well as difficulties in terms of a physical interpretation that have caused it to remain controversial since its inception. Only the one electron atom may be solved without approximations, but it fails to predict electron spin, leads to models with nonsensical consequences such as negative energy states of the vacuum, infinities, and negative kinetic energy, and it fails to predict the stability of the atomic hydrogen $n = 1$ state except for an arbitrary definition[72]. In addition to many predictions which simply do not agree with observations even regarding the one electron atom,[73] the Schrodinger equation predicts noncausality, nonlocality, spook actions at a distance or quantum telepathy, perpetual motion, and many internal inconsistencies where contradicting statements have to be taken true simultaneously. Recently, the behavior of free electrons in superfluid helium has again forced the issue of the meaning of the wavefunction. Electrons form bubbles in superfluid helium which reveal that the electron is real and that a physical interpretation of the wavefunction is necessary. Furthermore, when irradiated with light of energy of about a 0.5 to several electron volts, the electrons carry current at different rates as if they exist with different sizes. It has been proposed that the behavior of free electrons in superfluid helium can be explained in terms of the electron breaking into pieces at superfluid helium temperatures.[74] Yet, the electron has proven to be indivisible even under particle accelerator collisions at 90 GeV (LEPII). The nature of the wavefunction must now be addressed. It is time for the physical rather than the mathematical nature of the

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[72] The Schrodinger equation can only yield integer eigenvalue solutions by selection or definition from an infinite number of possibilities since the solution is over all space with no boundary (i.e. 0 to ∞). In contrast, wave equation solutions with integers are common for boundary constrained systems such as waveguides and resonators.

[73] References 32 and 45.

[74] Reference 50.

wavefunction to be determined.

A classical quantum mechanics (CQM) theory is herein derived from first principles that successfully applies physical laws on all scales. CQM gives closed form physical solutions for the electron in atoms, the free electron, and the free electron in superfluid helium. The prediction of fractional principal quantum energy states of the electron in liquid helium match the photoconductivity and mobility observations without requiring that the electron is divisible.[75]

In CQM, the classical wave equation is solved with the constraint that a bound electron cannot radiate energy. The mathematical formulation for zero radiation based on Maxwell's equations follows from a derivation by Haus.[76] The function that describes the motion of the electron must not possess spacetime Fourier components that are synchronous with waves traveling at the speed of light. CQM gives closed form solutions for the atom including the stability of the $n = 1$ state and the instability of the excited states, relativistic invariance of the wave equation, the equation of the photon and electron in excited states, the equation of the free electron, and photon which predict the wave particle duality behavior of particles and light. The current and charge density functions of the electron may be directly physically interpreted. For example, spin angular momentum results from the motion of negatively charged mass moving systematically, and the equation for angular momentum, $\mathbf{r} \times \mathbf{p} = \hbar$, can be applied directly to the wave function (a current density function) that describes the electron. A partial listing of well-known and documented phenomena which are derivable in closed form from CQM based on Maxwell's equations are given in Table 2. The calculations agree with experimental observations.

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[75] Reference 32.

[76] Reference 49.

Table 2. Partial List of Physical Phenomena Solved by CQM.

• Magnetic moment of a Bohr magneton	• Excited states of the helium atom
• Stern Gerlach experiment	• Davisson Germer experiment
• Electron and muon g factors	• Elastic electron scattering from helium atoms
• Lamb shift	• Proton scattering from atomic hydrogen
• Resonant line width and shape	• Nature of the chemical bond
• Selection rules	• Bond energies, vibrational energies, rotational energies, and bond distances of hydrogen-type molecules and molecular ions
• Photoelectric effect	• Superconductivity and Josephson junction experiments
• Compton effect	• Integral and fractional quantum Hall effects
• Correspondence principle	• Aharonov-Bohm effect
• Wave particle duality	• Aspect experiment
• Excited states	• Durr experiment on the Heisenberg Uncertainty Principle
• Reduced mass	• Penning trap experiments on single ions
• Rotational energies and momenta	• Hyperfine structure interval of positronium
• Orbital and spin splitting	• Magnetic moments of the nucleons
• Spin-orbital coupling	• Beta decay energy of the neutron
• Knight shift and spin-nuclear coupling	• Binding energy of deuterium
• Ionization of multielectron atoms	• Alpha decay

For any kind of wave advancing with limiting velocity and capable of transmitting signals, the equation of front propagation is the same as the equation for the front of a light wave. By applying this condition to electromagnetic and gravitational fields at particle production, the Schwarzschild metric (SM) is derived from the classical wave equation which modifies general relativity to include conservation of spacetime in addition to momentum and mass/energy. The result gives a natural relationship between Maxwell's equations, special relativity, and general relativity. It gives gravitation from the atom to the cosmos. The universe is time harmonically oscillatory in matter, energy, and spacetime expansion and contraction with a minimum radius that is the gravitational radius. A partial listing of the particle and cosmological phenomena derivable from CQM in closed form equations with fundamental constants only is given in Table 3.

Table 3. Partial List of Particle and Cosmological Phenomena Solved by CQM.

• Deflection of light by stars	• Power spectrum of the universe
• Precession of the perihelion of Mercury	• Microwave background temperature
• Lepton masses	• Uniformity of the microwave background radiation
• Quark masses	• Microkelvin spatial variation of the microwave background radiation measured by DASI
• Hubble constant	• Observed violation of the GZK cutoff
• Age of the universe	• Mass density of the universe
• Observed acceleration of the expansion	• Large scale structure of the universe
• Power of the universe	

CQM further gives the identity of dark matter which matches the criteria for the structure of galaxies and spectral lines from interstellar medium and the Sun which have been observed in the laboratory.[77] In a special case wherein the gravitational potential energy density of a blackhole equals that of the Planck mass, matter converts to energy and spacetime expands with the release of a gamma ray burst. The singularity in the SM is eliminated.

After decades of futility, QM and the Heisenberg Uncertainty Principle have not yielded a unified theory, are still purely mathematical, and have yet to be shown to be based in reality.[78] Both are based on circular arguments that the electron is a probability wave requiring that the electron have multiple positions and energies including negative and infinite energies simultaneously. Both are postulated, cannot be proven experimentally, and predict consequences such as violation of conservation of energy and momentum and an essentially infinite cosmological constant [References 32 and 54]. These predictions are not in agreement with experimentation. Furthermore, it was recently proven experimentally that the Heisenberg Uncertainty principle has nothing to do with wave-particle duality [Reference 55, and the Wave-Particle Duality is Not Due to the Uncertainty Principle section]; whereas, the opposite is largely touted as one of its triumphs.

In contrast, the predictions of CQM are unprecedented in that agreement with observations is achieved over 85 orders of magnitude from the scale of

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[77] References 13 and 21.

[78] Reference 32.

fundamental particles to that of the cosmos. Observable features of atomic particles such as the electron g factor may be calculated in closed form from Maxwell's equations with 11 figure accuracy without invoking the vagaries and inconsistencies inherent with QM and the Heisenberg Uncertainty Principle.

The following is from footnote 3 of the Forward section of R. Mills, The Grand Unified Theory of Classical Quantum Mechanics, September 2001 Edition:

From the time of its inception, quantum mechanic (QM) has been controversial because its foundations are in conflict with physical laws and are internally inconsistent. Interpretations of quantum mechanics such as hidden variables, multiple worlds, consistency rules, and spontaneous collapse have been put forward in an attempt to base the theory in reality. Unfortunately many theoreticians ignore the requirement that the wave function must be real and physical in order for it to be considered a valid description of reality. For example, regarding this issue Fuchs and Peres believe "Contrary to those desires, quantum theory does *not* describe physical reality. What it does is provide an algorithm for computing *probabilities* for macroscopic events ("detector ticks") that are the consequences of our experimental interventions. This strict definition of the scope of quantum theory is the only interpretation ever needed, whether by experimenters or theorists."[79]

With Penning traps, it is possible to measure transitions including those with hyperfine levels of electrons of single ions. This case can be experimentally distinguished from statistics over equivalent transitions in many ions. Whether many or one, the transition energies are always identical within the resonant line width. So, *probabilities* have no place in describing atomic energy levels. Moreover, quantum theory is incompatible with probability theory as shown in Mills publication.[80]

The Copenhagen interpretation provides another meaning of quantum mechanics. It asserts that what we observe is all we can know; any speculation about what an electron, photon, atom, or other atomic-sized entity is really is or what it is doing when we are not looking is just that—speculation. The postulate of quantum measurement asserts that the process of measuring an observable forces it into a state of reality. In other words, reality is irrelevant until a measurement is made. In the case of electrons in helium, the fallacy with this position is that the "ticks" (migration times of electron bubbles) reveal that the

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[79] Reference 51.

[80] Reference 32.

electron is real before a measurement is made.[81] Furthermore, experiments on Ba^+ in a Penning trap discussed in the Inconsistencies of Quantum Mechanics section demonstrate that the postulate of quantum measurement of quantum mechanics is experimentally disproved. These issues and other such flawed philosophies and interpretations of experiments that arise from quantum mechanics are discussed in the Retrospect section and Mills publication.[82]

QM gives correlations with experimental data. It does not explain the mechanism for the observed data. But, it should not be surprising that it gives good correlations given that the constraints of internal consistency and conformance to physical laws are removed for a wave equation with an infinite number of solutions wherein the solutions may be formulated as an infinite series of eigenfunctions with variable parameters. There are no physical constraints on the parameters. They may even correspond to unobservables or "flights of fantasy" such as probability waves, virtual particles, negative energy of the vacuum, polarization of the vacuum by virtual particles, infinities, renormalization, effective nuclear charge, ionic terms in the perturbation series, fermion propagators, virtual photon annihilation, virtual photon emission and reabsorption, virtual electron positron annihilation, photon propagators, plethora of postulated super-symmetry virtual particles which make contributions such as smuon-neutralino and sneutrino-chargino loops, neutrino oscillation, worm holes, parallel universes, hyperdimensions, parallel mind universes, quantum telepathy, entanglement, spooky actions at a distance, faster than light travel, dark energy, exotic particles comprising dark matter, the universe from nothing, big bang-inflation-deceleration-reacceleration of the universe, and so on and so on. With mathematics, it is possible to represent an infinite number of models with limitless fantasy. If you invoke the constraints of internal consistency and conformance to physical laws, quantum mechanics has never successfully solved a physical problem.

Throughout the history of quantum theory, wherever there was an advance to a new application, it was necessary to repeat a trial and error experimentation to find which method of calculation gave the right answers. Often the textbooks present only the successful procedure as if it followed from first principles; and do not mention the actual method by which it was found. In electromagnetic theory based on Maxwell's equations, one deduces the computational algorithm from the general principles. In quantum theory, the logic is just the opposite. One chooses the principle to fit the empirically successful algorithm. For example, we know that it required a great deal of art and tact over decades of effort to get correct predictions out of Quantum Electrodynamics (QED). For the right experimental

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[81] Reference 32.

[82] Reference 32.

numbers to emerge, one must do the calculation (i.e. subtract off the infinities) in one particular way and not in some other way that appears in principle equally valid. There is a corollary, noted by Kallen: from an inconsistent theory, any result may be derived.

Reanalysis of old experiments and many new experiments including electrons in superfluid helium challenge the Schrodinger equation predictions. Many noted physicists rejected quantum mechanics. Feynman also attempted to use first principles including Maxwell's Equations to discover new physics to replace quantum mechanics [Reference 52]. Other great physicists of the 20th century searched. "Einstein ... insisted ... that a more detailed, wholly deterministic theory must underlie the vagaries of quantum mechanics" [Reference 53]. He felt that scientists were misinterpreting the data. Examples of quantum mechanical misinterpretations of experiments are:

1.) The rise in current of free electrons in superfluid helium when irradiated with low-energy light and the formation of an unexpected plethora of exotic negative charge carriers in superfluid helium with mobilities greater than that of the normal electron are due to the electron breaking into fractional pieces.

2.) Virtual particles surround the electron, and as the electron's center is approached, they shield the electron's charge less effectively.

3.) Spooky actions at a distance are predicted.

4.) A $^9Be^+$ ion may be in two separate locations at once.

5.) Supercurrent may go in both directions at once.

6.) Perpetual motion is predicted.

7.) A weak force is observed between the two precision machined plates with minuscule separation because the plates serve to limit the number of virtual particle modes between the plates as opposed to those outside the plates and the resulting imbalance in pressure between two infinite quantities gives rise to the feeble force known as the Casimir effect.

8.) The *postulated* Quantum Electrodynamics (QED) theory of $\frac{g}{2}$ is based on the determination of the terms of a *postulated* power series in α/π where each *postulated* virtual particle is a source of *postulated* vacuum polarization that gives

rise to a *postulated* term. The algorithm involves scores of *postulated* Feynman diagrams corresponding to thousands of matrices with thousands of integrations per matrix requiring decades to reach a consensus on the "appropriate" *postulated* algorithm to remove the intrinsic infinities.

9.) The muon g factor g_μ is required to be different from the electron g factor in the standard model due to the mass dependent interaction of each lepton with vacuum polarizations due to virtual particles. The BNL Muon (g-2) Collaboration used a "magic" $\gamma = 29.3$ which satisfied the BMT equation identically for the theoretical value of $\frac{g_\mu}{2}$ with assumption that $\frac{g_\mu}{2} \neq \frac{g_e}{2}$ and obtained a measured result that was internally consistent.

10.) The expansion of the universe is accelerating due to the presence of "dark energy" throughput all space.

THEN THERE IS REALITY:

1.) Fractional principal quantum energy states of the electron in liquid helium match the photoconductivity and mobility observations without requiring that the electron is divisible.

2.) The electron is an extended particle rather than a point, and the charge density is greatest in the center.

3.) Photon momentum is conserved on a photon by photon basis rather than statistically as predicted by quantum mechanics which predicts photon coincidence counts at separated detectors (Aspect experiment).

4.) The fluorescence emission spectrum of a Penning trapped $^9Be^+$ ion shows interference peaks due to coupling between oscillator modes and a Stern Gerlach transition.

5.) The energy difference of a superconducting loop observed by Friedman et al. matches the energy corresponding to the flux linkage of the magnetic flux quantum by the ensemble of superconducting electrons in their entirety with a reversal of the corresponding macroscopic current.

6.) Perpetual motion is not permitted or observed.

7.) The Casimir effect is predicted by Maxwell's equations wherein the attractive force is due only to the interactions of the material bodies themselves. Charge and current fluctuations in a material body with a general susceptibility serve as source terms for Maxwell's equations, i.e. classical fields, subject to the boundary conditions presented by the body surfaces. In the limiting case of rarefied media, the van der Waals force of interaction between individual atoms is obtained.

8.) The remarkable agreement between Eqs. (1.204) and (1.205) of the Electron g Factor section demonstrates that $\frac{g}{2}$ may be derived in closed form from Maxwell's equations in a simple straight forward manner that yields a result with eleven figure agreement with experiment—the limit of the experimental capability of the measurement of the fundamental constants that determine α.

9.) Rather than indicating an expanded plethora of postulated super-symmetry virtual particles which make contributions such as smuon-neutralino and sneutrino-chargino loops, the muon, like the electron, is a lepton with $\hbar$ of angular momentum, and the muon and electron g factors are predicted by CQM to be identical. Using the experimental "magic" $\gamma = 29.3$ and $\frac{g_\mu}{2} = \frac{g_e}{2}$ in the BMT equation, the predicted measurement exactly matched $\frac{g_\mu}{2}$ measured by the BNL Muon (g-2) Collaboration proving that their assumption that the $\gamma = 29.3$ condition eliminated the affect of the electrostatic field on ω_a was flawed and showed the equivalence of the muon and electron g factors.

10.) The constant maximum speed, c, for the propagation of light and gravity results in the conservation relationship of mass/energy, $E = mc^2$ and spacetime, $\frac{c^3}{4\pi G} = 3.22 \times 10^{34} \frac{kg}{sec}$. Spacetime expands as mass is converted to energy, and the predictions match the observed Hubble constant and the acceleration of the expansion.

CQM explains the data based on reality versus fantastical interpretations of probability wave equation solutions. These examples are given in Appendix II: Quantum Electrodynamics is Purely Mathematical and Has No Basis in Reality, Appendix III: Muon g Factor, the Retrospect and Gravity sections [Reference 39],

and Mills publications [References 32 and 45].

2a. Applicant's response to the Secret Committee's position that "Quantum theory is the most successful theory in the history of science"

The Secret Committee is referring to the quantum electrodynamics, which is fatally flawed as shown in R. Mills, The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory.[83] Quantum electrodynamics permits perpetual motion of the first and second kinds and predicts an infinite cosmological constant, which conclusively proves that quantum electrodynamics does not represent reality and cannot properly be relied upon as a basis to reject Applicant's technology.

The success of quantum electrodynamics can be attributed to unlimited lack of rigor and abandonment to adherence to physical laws. This point has been peer-reviewed and published by Applicant, in R. Mills, The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory, Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096, which states:

> Throughout the history of quantum theory; wherever there was an advance to a new application, it was necessary to repeat a trial-and -error experimentation to find which method of calculation gave the right answers. Often the textbooks present only the successful procedure as if it followed from first principles; and do not mention the actual method by which it was found. In electromagnetic theory based on Maxwell's equations, one deduces the computational algorithm from the general principles. In quantum theory, the logic is just the opposite. One chooses the principle to fit the empirically successful algorithm. For example, we know that it required a great deal of art and tact over decades of effort to get correct predictions out of Quantum Electrodynamics (QED). For the right experimental numbers to emerge, one must do the calculation (i.e. subtract off the infinities) in one particular way and not in some other way that appears in principle equally

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[83] Reference 32.

valid. There is a corollary , noted by Kallen: from an inconsistent theory, any result may be derived. If internally consistency and adherence to physical laws are invoked, quantum mechanic has never successfully solved a physical problem.

Taking from R. Mills, The Grand Unified Theory of Classical Quantum Mechanics, September 2001 Edition Chapter 1, pp. 99-101:

The *postulated* QED theory of $\frac{g}{2}$ is based on the determination of the terms of a *postulated* power series in α/π where each *postulated* virtual particle is a source of *postulated* vacuum polarization that gives rise to a *postulated* term. The algorithm involves scores of *postulated* Feynman diagrams corresponding to thousands of matrices with thousands of integrations per matrix requiring decades to reach a consensus on the "appropriate" *postulated* algorithm to remove the intrinsic infinities. The remarkable agreement between Eqs. (1.204) and (1.205) demonstrates that $\frac{g}{2}$ may be derived in closed form from Maxwell's equations in a simple straightforward manner that yields a result with eleven figure agreement with experiment—the limit of the experimental capability of the measurement of the fundamental constants that determine α. In Appendix II: Quantum Electrodynamics is Purely Mathematical and Has No Basis in Reality, the Maxwellian result is contrast with the QED algorithm of invoking virtual particles, zero point fluctuations of the vacuum, and negative energy states of the vacuum.

The muon, like the electron, is a lepton with $\hbar$ of angular momentum. The magnetic moment of the muon is given by Eq. (1.136) with the electron mass replaced by the muon mass. It is twice that from the gyromagnetic ratio as given by Eq. (2.36) of the Orbital and Spin Splitting section corresponding to the muon mass. As is the case with the electron, the magnetic moment of the muon is the sum of the component corresponding to the kinetic angular momentum, $\frac{\hbar}{2}$, and the component corresponding to the vector potential angular momentum, $\frac{\hbar}{2}$, (Eq. (1.132). The spin-flip transition can be considered as involving a magnetic moment of g times that of a Bohr magneton of the muon. The g factor is equivalent to that of the electron given by Eq. (1.196).

The muon anomalous magnetic moment has been measured in a new experiment at Brookhaven National Laboratory (BNL) [29]. Polarized muons were stored in a superferric ring, and the angular frequency difference ω_a between the spin precession and orbital frequencies was determined by measuring the time distribution of high-energy decay positrons. The dependence of ω_a on the

magnetic and electric fields is given by BMT equation which is the relativistic equation of motion for spin in uniform or slowly varying external fields [30]. The dependence on the electric field is eliminated by storing muons with the "magic" $\gamma = 29.3$, which corresponds to a muon momentum $p = 3.09 \, GeV/c$. Hence measurement of ω_a and of B determines the anomalous magnetic moment.

The "magic" γ wherein the contribution to the change of the longitudinal polarization by the electric quadrapole focusing fields are eliminated occurs when

$$\frac{g_\mu \beta}{2} - \frac{1}{\beta} = 0 \qquad (1.206)$$

where g_μ is the muon g factor which is required to be different from the electron g factor in the standard model due to the dependence of the mass dependent interaction of each lepton with vacuum polarizations due to virtual particles. For example, the muon is much heavier than the electron, and so high energy (short distance) effects due to strong and weak interactions are more important here [26]. The BNL Muon (g-2) Collaboration [29] used a "magic" $\gamma = 29.3$ which satisfied Eq. (1.206) identically for $\frac{g_\mu}{2}$; however, their assumption that this condition eliminated the affect of the electrostatic field on ω_a is flawed as shown in Appendix III: Muon g Factor. Internal consistency was achieved during the determination of $\frac{g_\mu}{2}$ using the BMT equation with the flawed assumption that $\frac{g_\mu}{2} \neq \frac{g_e}{2}$. The parameter measured by Carey et al. [29] corresponding to $\frac{g_\mu}{2}$ was the sum of a finite electric term as well as a magnetic term. The calculated result based on the equivalence of the muon and electron g factors

$$\frac{g_\mu}{2} = 1.001 \; 165 \; 923 \qquad (1.207)$$

is in agreement with the result of Carey et al. [29]:

$$\frac{g_\mu}{2} = 1.001 \; 165 \; 925 \; (15) \qquad (1.208)$$

Rather than indicating an expanded plethora of postulated super-symmetry virtual particles which make contributions such as smuon-neutralino and sneutrino-chargino loops as suggested by Brown et al. [31], the deviation of the experimental value of $\frac{g_\mu}{2}$ from that of the standard model prediction simply indicates that the muon g factor is identical to the electron g factor.

Taking from R. Mills, The Grand Unified Theory of Classical Quantum Mechanics, September 2001 Edition Appendix II: Quantum Electrodynamics (QED) is Purely Mathematical and Has No Basis in Reality:

Throughout the history of quantum theory; wherever there was an advance to a new application, it was necessary to repeat a trial-and -error experimentation to find which method of calculation gave the right answers. Often the textbooks present only the successful procedure as if it followed from first principles; and do not mention the actual method by which it was found. In electromagnetic theory based on Maxwell's equations, one deduces the computational algorithm from the general principles. In quantum theory, the logic is just the opposite. One chooses the principle to fit the empirically successful algorithm. For example, we know that it required a great deal of art and tact over decades of effort to get correct predictions out of QED. The QED method of the determination of $(g-2)/2$ from the *postulated* Dirac equation is based on a *postulated* powers series of α/π where each *postulated* virtual particle is a source of *postulated* vacuum polarization that gives rise to a *postulated* term which is processed over decades using ad hoc rules to remove infinities from each term that arises from *postulated* scores of *postulated* Feynman diagrams. Mohr and Taylor reference some of the Herculean efforts to arrive at g using QED [42]:

"the sixth-order coefficient $A_1^{(6)}$ arises from 72 diagrams and is also known analytically after nearly 30 years of effort by many researchers [see Roskies, Remiddi, and Levine (1990) for a review of the early work]. It was not until 1996 that the last remaining distinct diagrams were calculated analytically, thereby completing the theoretical expression for $A_1^{(6)}$".

For the right experimental numbers to emerge, one must do the calculation (i.e. subtract off the infinities) in one particular way and not in some other way that appears in principle equally valid. For example, Milonni [43] presents a QED derivation of the magnetic moment of the electron which gives a result of the wrong sign and requires the introduction of an

"upper limit K in the integration over $k = \omega/c$ in order to avoid a divergence."

A differential mass is arbitrarily added, then

"the choice $K = 0.42 mc/\hbar$ yields $(g-2)/2 = \alpha/2\pi$ which is the relativistic QED result to first order in α. [...] However, the reader is warned not to take these calculations too seriously, for the result $(g-2)/2 = \alpha/2\pi$ could be obtained by retaining only the first (radiation reaction) term in (3.112) and choosing

$K = 3mc/8\hbar$. It should also be noted that the solution $K \cong 0.42mc/\hbar$ of (3.112) with $(g-2)/2 = \alpha/2\pi$ is not unique."

Such an ad hoc nonphysical approach makes incredulous:

" the cliché that QED is the best theory we have!" [44]

or the statement that:

"The history of quantum electrodynamics (QED) has been one of unblemished triumph" [45].

There is a corollary, noted by Kallen: from an inconsistent theory, any result may be derived.

The QED determination of the postulated power series in α/π is based on scores of Feynman diagrams corresponding to thousands of matrices with thousands of integrations per matrix requiring decades to reach a consensus on the "appropriate" algorithm to remove the intrinsic infinities. Remarkably, $(g-2)/2$ may be derived in closed form from Maxwell's equations in a simple straightforward manner that yields a result with eleven figure agreement with experiment—the limit of experimental capability. The derivation from first principles without invoking virtual particles, zero point fluctuations of the vacuum, and negative energy states of the vacuum is given in the Electron g Factor section.

Furthermore, Oskar Klein pointed out a glaring paradox implied by the Dirac equation which was never resolved [46]. "Electrons may penetrate an electrostatic barrier even when their kinetic energy, $E - mc^2$ is lower than the barrier. Since in Klein's example the barrier was infinitely broad this could not be associated with wave mechanical tunnel effect. It is truly a paradox: Electrons too slow to surpass the potential, may still only be partially reflected. ...Even for an infinitely high barrier, i.e. $r_2 = 1$ and energies $\approx 1\ MeV$, (the reflection coefficient) R is less than 75%! From (2) and (3) it appears that as soon as the barrier is sufficiently high: $V > 2mc^2$, electrons may transgress the repulsive wall-seemingly defying conservation of energy. ...Nor is it possible by way of the positive energy spectrum of the free electron to achieve complete Einstein causality."

The Rutherford experiment demonstrated that even atoms are comprised of essentially empty space [47]. Zero-point field fluctuations, virtual particles, and states of negative energy and mass invoked to describe the vacuum are nonsensical and have no basis in reality since they have never been observed

experimentally and would correspond to an essentially infinite cosmological constant throughout the entire universe including regions of no mass. As given by Waldrop [48], "What makes this problem into something more than metaphysics is that the cosmological constant is observationally zero to a very high degree of accuracy. And yet, ordinary quantum field theory predicts that it ought to be enormous, about 120 orders of magnitude larger than the best observational limit. Moreover, this prediction is almost inescapable because it is a straightforward application of the uncertainty principle, which in this case states that every quantum field contains a certain, irreducible amount of energy even in empty space. Electrons, photons, quarks—the quantum field of every particle contributes. And that energy is exactly equivalent to the kind of pressure described by the cosmological constant. The cosmological constant has accordingly been an embarrassment and a frustration to every physicist who has ever grappled with it."

Furthermore, a consequence of the Heisenberg Uncertainty principle and QED is that matter may be created from nothing, including vacuum. Taking quantum theory into account, Stephen Hawking [49-50] mathematically proved that blackholes must emit Hawking radiation comprising photons, neutrinos, and all sorts of massive particles. "The surface emits with equal probability all configurations of particles compatible with the observers limited knowledge. It is shown that the ignorance principle holds for quantum-mechanical evaporation of blackholes: The black hole creates particles in pairs, with one particle always falling into the hole and the other possibly escaping to infinity [50]." This QM theorem represents a perpetual motion machine with regard to spontaneous creation of mass and energy from the vacuum and with regard to gravitation. (QM also predicts a perpetual motion machine of the second kind [51-52]). Contrary to prediction, Hawking radiation has never been observed [53-55]. Classical laws including conservation of matter-energy are confirmed and QM is invalidated.

QED is further shown to be experimentally incorrect. Mobility measurements and spectroscopy directly show that electrons may be trapped in superfluid helium as autonomous electron bubbles interloped between helium atoms that have been excluded from the space occupied by the bubble. Electrons bubbles in superfluid helium reveal that the electron is real and that a physical interpretation of the wavefunction is necessary. The electron orbitsphere representation matches the data identically and is also in agreement with scattering experiments, another direct determination of the nature of the electron.[84]

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[84] Reference 32.

3. Applicant's response to the Secret Committee's "Response to applicant's position that classical physics describes reality on all scales"

Classical physical laws can explain theoretical observations from the scale of the atom to the cosmos as shown by Applicant.[85] These classical laws include Maxwell's equations and special relativity with which Applicant's theory is fully compliant including the relativistic invariance of the wave equation.[86] The Schrodinger equation is not relativistically invariant and the Dirac equation is fatally flawed since it demands the existence of virtual particle in every point of space which gives rise to an infinite cosmological constant as well as other catastrophic consequences such as the violation of the first law of thermodynamics .[87]

Data which has been erroneously interpreted in terms of quantum mechanics as spooky actions at a distance, violation of causality, a beryllium ion on two separate places at once, etc. are shown by Applicant to be rigorously explicable by first principles laws.[88] Furthermore, Applicant shows that quantum mechanics is flawed—it makes at least 18 predictions regarding the one electron atom which are not in agreement with experimental observation.[89] Citing self promoting statements by quantum mechanical theoreticians changes nothing in this. Furthermore, the Secret Committee confuses the consequences of the perturbation of a system by a measurement and the implications of the Uncertainty Principle. The former case can be treated purely classically by the rise time-band width relationship based on conservation of energy.[90]

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[85] Reference 39.

[86] Reference 39, Chapter I.

[87] Reference 39, Appendix II: Quantum Electrodynamics (QED) is Purely Mathematical and Has No Basis in Reality.

[88] Reference 39, Forward section and Chapter 37, and Reference 32.

[89] References 32 and 45.

[90] Reference 39, Chapter 2.

The Heisenberg Uncertainty Principle is not a law of nature. It is based on circular arguments that the electron is a probability wave requiring that the electron have multiple positions and energies including negative and infinite energies simultaneously.[91] Both are postulated, cannot be proven experimentally, and predict consequences such as violation of conservation of energy and momentum and an essentially infinite cosmological constant. These predictions are not in agreement with experimentation. Furthermore, it was recently proven experimentally that the Heisenberg Uncertainty principle has nothing to do with wave-particle duality;[92] whereas, the opposite is largely touted as one of its triumphs. In contrast, the observable features of atomic particles such as the electron g factor may be calculated in closed form from Maxwell's equations with 11 figure accuracy without invoking the vagaries and inconsistencies inherent with the Heisenberg Uncertainty Principle. [93]

The Secret Committee cites a summary of the results of Hydrino theory. The rigorous derivation are found in R. Mills, The Grand Unified Theory of Classical Quantum Mechanics, September 2001 Edition, Chapter 5. The Committee also has it backwards. The experimental results summarized in Section I of this Response proves hydrinos. The extreme position taken by the Committee that these states are prohibited from existence based on quantum mechanics—a probability wave theory which is purely mathematical, postulated, and inconsistent with physical laws that flatly fails in many aspects as shown by Applicant[94]—is totally baseless.

As shown in R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183:

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[91]References 32, 45, and 39 at Forward section, and Chapter 37.

[92]References 32, 45, and 39 at Forward section and Chapter 37.

[93] References 27 and 39.

[94] References 32, 39 and 45.

Eq. (47) is the differential equation for associated Laguerre functions given in general form by

$$xy'' + 2y' + \left[n* - \frac{k-1}{2} - \frac{x}{4} - \frac{k^2-1}{4x} \right] y = 0 \qquad (48)$$

which has a solution possessing an integrable square of the form

$$y = e^{-x/2} x^{(k-1)/2} L_{n*}^k (x) \qquad (49)$$

provided that $n*$ and k are positive integers. However, $n*$ does not have to be an integer, it may be any *arbitrary* constant β.

It should further be pointed out that the current Schrodinger equation solution for highly excited states and continuum states are nonsensical—the wavefunctions are sinusoidal over all space and can not be normalized; thus each is infinite .[95]

In addition, it is shown by Applicant that the Schrodinger equation can be solved for states n = 1 / integer equally well as those where n = integer .[96]

A further irony in the Secret Committee's position vis-a-vis Applicant is that:[97]

The theories of Bohr, Schrödinger, and presently Applicant all give the identical equation for the principal energy levels of the hydrogen atom.

$$E_{ele} = -\frac{Z^2 e^2}{8\pi\varepsilon_o n^2 a_H} = -\frac{Z^2}{n^2} X\, 2.1786\, X10^{-18}\, J = -Z^2 X \frac{13.598}{n^2}\, eV \qquad (1)$$

Applicant's theory solves the two dimensional wave equation for the charge density function of the electron. And, the Fourier transform of the charge density function is a solution of the three-dimensional wave equation in frequency (k,ω) space. Whereas, the Schrödinger equation solutions are three dimensional in spacetime. The energy is given by

$$\int_{-\infty}^{\infty} \psi H \psi dv = E \int_{-\infty}^{\infty} \psi^2 dv; \qquad (2)$$

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[95] Reference 32 and 45.

[96] Reference 32.

[97] Reference 39, Forward section, the derivation is given in the Introduction section.

$$\int_{-\infty}^{\infty} \psi^2 dv = 1 \tag{3}$$

Thus,

$$\int_{-\infty}^{\infty} \psi H \psi dv = E \tag{4}$$

In the case that the potential energy of the Hamiltonian, H, is a constant times the wavenumber, the Schrödinger equation is the well known Bessel equation. Then with one of the solutions for ψ, Eq. (4) is equivalent to an inverse Fourier transform. According to the duality and scale change properties of Fourier transforms, the energy equation of the present theory and that of quantum mechanics are identical, the energy of a radial Dirac delta function of radius equal to an integer multiple of the radius of the hydrogen atom (Eq. (1)). And, Bohr obtained the same energy formula by postulating nonradiative states with angular momentum

$$L_z = m\hbar \tag{5}$$

and solving the energy equation classically.

The Schrodinger equation can only yield integer eigenvalue solutions by selection or definition from an infinite number of possibilities since the solution is over all space with no boundary (i.e. 0 to ∞). In contrast, wave equation solutions with integers are common for boundary constrained systems such as waveguides and resonators.

From R. Mills, The Grand Unified Theory of Classical Quantum Mechanics, September 2001 Edition, Introduction section, page 19:

> The mathematical relationship of Mills theory and quantum mechanics is based on the Fourier transform of the radial function. Mills theory requires that the electron is real and physically confined to a two dimensional surface which corresponds to a solution of the two-dimensional wave equation plus time. The corresponding Fourier transform is a wave over all space which is a solution of the three dimensional wave equation (e.g. the Schrödinger equation). In essence quantum mechanics may be considered as a theory dealing with the Fourier transform of an electron rather than the physical electron. By Parseval's theorem, the energies may be equivalent, but the quantum mechanical case is nonphysical—only

mathematical. Thus, it is nonsensical from this perspective. It may mathematically produce numbers which agree with experimental energies, but the mechanisms lack internal consistency and conformity with physical laws. If these are the criterion for a valid solution of physical problems, then quantum mechanics has never successfully solved any problem. The theory of Bohr similarly failed.

What is clear from these facts is that quantum mechanics is purely mathematical and can yield any arbitrary formula for the energy levels of the hydrogen atom. Then the criteria on which to base the definition in the mathematics which constrains and selects a set from the infinite possibilities depends on the experimental data. It can be argued than that spectroscopic and supporting data are the pillars upon which modern atomic theories are built—that data discussed in the Section I of this Response shows that lower-energy hydrogen exists and at the very least the solution corresponding to energy level with $n = 1/\text{integer}$ must be added to those corresponding to $n = \text{integer}$ as shown by Applicant even in the case of the Schrodinger equation.[98]

Furthermore, these data challenge the Secret Committee's position directly. For example, the catalyst product of Rb^+ and two K^+, $H(1/2)$, was predicted to be a highly reactive intermediate which further reacts to form a novel hydride ion $H^-(1/2)$. This hydride ion with a predicted binding energy of 3.0468 eV was observed by high resolution visible spectroscopy as a broad peak at 4070.0 Å with a FWHM of 1.4 Å. From the electron g factor, bound-free hyperfine structure lines of $H^-(1/2)$ were predicted with energies E_{HF} given by $E_{HF} = j^2 3.0056 \, X \, 10^{-5} + 3.0575 \, eV$ (j is an integer) as an inverse Rydberg-type series that converges at increasing wavelengths and terminates at 3.0575 eV—the hydride spin-pairing energy plus the binding energy. The high resolution visible plasma emission spectra in the region of 4000 Å to 4060 Å matched the predicted emission lines for $j = 1$ to $j = 37$ to 1 part in 10^5 .[99]

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[98] Reference 32.

[99] Reference 2 and 7.

This data further reinforces Applicant's argument that quantum electrodynamics is not the most successful theory in history as alleged by the Secret Committee. It is disproved by this data as well. That is, good science with sound experimental data disproves **bad** theory. **DATA** takes precedence over theory.

On page 10, second paragraph, in the Attachment to the Final Office Action, the Secret Committee states:

> In view of the above discussion, it would have come as no surprise to one of ordinary skill in the art that the improper use of a theory, such as applicant's classical theory, to explain phenomena in a quantum domain, such as the behavior of electrons in atoms, can all too easily lead to erroneous conclusions such as the existence of a "hydrino atom."

All theories must be tested experimentally. If the theory does not comply with the experiments, then it is "erroneous" as pointed out by the Secret Committee. This standard also applies to the Quantum Theory relied upon by the Committee. Since the experimental evidence of record conclusively demonstrates the hydrino atom (lower-energy hydrogen), Applicant's theory is validated and Quantum Theory is disproven. A disproven theory cannot be relied upon to ignore experimental evidence and denigrate Applicant's theory. Applicant's theory predicted the very same hydrino atom, which subsequently was proven by experimental evidence. Thus, by definition, use of Applicant's theory is not improper nor does it provide erroneous conclusions.

On page 10, last paragraph to page 11, third paragraph, in the Office Action, the Secret Committee cites Tegmark and Wheeler at p. 69:

> "The astonishing range of scientific and practical applications of quantum mechanics undergrids: today an estimated 30 percent of the U.S. gross national product is based on inventions made possible by quantum mechanics, from semiconductors in computer chips to lasers in compact-disc players, magnetic resonance imaging in hospitals, and much more."

It is true that technologies have been developed that are based on the phenomenon of quantization. But, it can not be said that these technologies would not exist if it were not for probability wave equations (i.e. the Schrodinger equation). This self grandeur of Wheeler is simply nonsense. According to Wheeler, not only technologies but also the existence of the entire universe is dependent on the human mind. In Wheeler's quantum mechanical view of reality, the existence of a computer, a CD player, or an MRI scanner relies upon the human mind to collapse the quantum wavefunction to make these objects real.[100] The Secret Committee is advised to read the original transistor patent, in which case it will find that it contains NO MENTION OF QUANTUM MECHANICS. It is based purely on empirical material science.

The invention of the transistor was based on phenomenology. The invention of the transistor is covered in Proceedings of the IEEE "Special Issue on the Fiftieth Anniversary of the Transistor", Vol. 86, No. 1, January, (1998). At page 34-36, Shockley's Patent is printed. It is not based on quantum mechanics. It is an engineering description of an amplifier based on properties of semiconductor materials arranged in a particular fashion.

There is no solution of the Schrodinger equation used in solid state physics. The discipline advances empirically and quantum mechanical hand-waving is added after a discovery. Examples include the quantum and integral Hall effects. Then there is the stifling of technology by quantum mechanics. For example, theoreticians violently insisted that high temperature superconductivity could not be possible since it violated BCS theory (incidentally a Noble prize was awarded for the DISCOVERY of high temperature superconductivity and the phenomenon can still not be explained by quantum mechanics theory). The Secret Committee should also note as stated by Weinstein in Section I of this report, that chemists have been impeded by quantum mechanics.

Then there is the laser. Stimulated emission started with Einstein as an additional term to

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[100] Reference 53.

empirically fit Planck's blackbody radiator curve. The laser is completely explained by Maxwell's equations using the mere empirical observation of quantized energy levels.

The invention of the laser was based more on classical physics applied to observed quantum phenomenon. The idea of stimulated emission originated in 1917 (ten years before the Schrodinger equation was postulated) when Einstein proposed that Planck's formula for blackbody radiation could be obtained from an ensemble of atoms with quantized energy levels that under went stimulated and as well as spontaneous emission.[101] This idea was used by Schawlow and Townes in an extension of classical microwave resonator cavity theory to propose the extension of MASER techniques to visible wavelengths.[102] Masers were originally described classically given the phenomenon of quantization—not by using the Schrodinger equation.

What is even more devastating to the Secret Committee's argument is that the mere existence of the laser disproves quantum mechanics and the Heisenberg Uncertainty Principle as pointed out by Carver Meade, Gordon and Betty Moore Professor of Engineering and Applied Science at Caltech, Feynman's former student, colleague and collaborator, as well as Silicon Valley's physicist in residence and leading intellectual, who was recently interviewed on this subject:[103]

> Central to Mead's rescue project are a series of discoveries inconsistent with the prevailing conceptions of quantum mechanics. One was the laser. As late as 1956, Bohr and Von Neumann, the paragons of quantum theory, arrived at the Columbia laboratories of Charles Townes, who was in the process of describing his invention. With the transistor, the laser is one of the most important inventions of the twentieth century. Designed into every CD player and long distance telephone connection, lasers today are manufactured by the billions. At the heart of laser action is perfect alignment of the crests and troughs of myriad waves of light. Their location and momentum must be theoretically knowable. But this violates the holiest canon of Copenhagen theory: Heisenberg Uncertainty. Bohr and Von Neumann proved to be true believers in Heisenberg's rule. Both

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[101] Reference 66.

[102] Reference 67.

[103] Reference 68.

denied that the laser was possible. When Townes showed them one in operation, they retreated artfully.

In Collective Electrodynamics, Mead cites nine other experimental discoveries, from superconductive currents to masers, to Bose-Einstein condensates predicted by Einstein but not demonstrated until 1995. These discoveries of large-scale, coherent quantum phenomena all occurred after Bohr's triumph over Einstein.

Magnetic resonance is also described by Maxwell's equations. In fact, in a recent communication, Applicant was informed by Dr. Samuel Patz who heads the MRI Laboratory at the Brigham & Women's Hospital, Harvard Medical School's top research center, that MRI is taught at Harvard and Massachusetts Institute of Technology as the classical precession of the bulk magnetization vector in a frame rotating at the Larmor frequency due to the application of an applied RF field at the Larmor frequency wherein the bulk magnetization is due to the phenomenon of nuclear spin direction quantization.[104] The Schrodinger equation is not used, and the quantum theory of the nucleus, quantum chromodynamics (QCD), is an utter failure in that it can not predict the existence of the proton and neutron or correctly account for the phenomenon of nuclear spin; whereas, Applicant's theory can. From first principles, Applicant's theory predicts the masses of the proton and neutron and their magnetic moments to within a part per hundred thousand of the observed values in closed form equations containing fundamental constants only.[105]

Simply put, quantum mechanics has failed. It can not explain the most fundamental observations such as the nature of a photon, the electron, the wave-particles duality nature of light and particles (See Section 14 of this Response), the masses of particles, gravity, etc. It has been a complete failure at unification.[106] The Secret Committee has gone to great lengths to establish that Noble prizes have been award in the pursuit of quantum mechanics. The Committee has been diligent at pointing out celebrities of quantum physics. Notably absent from

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[104] Reference 69.

[105] Reference 39 at Proton and Neutron section.

[106] Reference 39, Forward and Introduction Sections.

the list are Newton, Einstein, and Maxwell. It doesn't matter how many theoreticians toil at trying to make quantum mechanics work or what fantasies they will tolerate in order to force it to work if it is based on a *false premise*. That false premise is that physical laws such as Maxwell's equations and Newton's laws with Einstein's special relativity do not apply at the atomic level. Physicists have justified the spookiness and absurd consequences of quantum mechanics on the basis that no theory based on physical laws can explain quantum phenomena, such as quantized nature of light and atomic energy levels and the wave-particle duality. This is absolutely *not true* as shown by Applicant.[107] Classical laws work over 85 orders of magnitude of scale from that of elementary particles to that of the cosmos. Science is not a popularity contest, it is the endless search for the ultimate truth of the workings of the physical universe established by empirical observation (I.E., ESTABLISHED BY DIRECT EXPERIMENTATION). Solipsistic nihilism and self grandeur have no place in science.

And, consider the impact on technology. We could live without quantum mechanics and only accept that empirical result that atomic energy levels are quantized. Quantum mechanics was not even adopted in any serious fashion until well after the seeds were sown for the major technologies cited by the Secret Committee. In contrast, classical laws—Maxwell's equations and Newton's laws—which the Committee argues against by advocating the mutually incompatible quantum mechanics—are ABSOLUTELY INDISPENSABLE FOR MODERN SOCIETY. They are absolutely predictive; whereas, quantum mechanics is NOT.

In contrast to Quantum mechanics, which has never predicted a single technology, Applicant's theory has predicted novel hydrogen chemistry, which is now experimentally confirmed as summarized in Section I of this Response. The match between theoretical predictions and experimental observation are remarkable. Applicant's predicted technology could eclipse the value of those cited by the Secret Committee and could in fact advance them

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[107] Reference 39.

significantly as shown in Applicant's published and soon-to-be published articles .[108]

4. Applicant's response to the Secret Committee's "Response to applicant's position that his theory is based on first principles"

Applicant's theory is indeed based on first principles; whereas, quantum mechanics is not. In fact, text books make it very clear that according to quantum mechanics, physical laws do not apply.[109] The specific principles and actual laws of nature rigorously adhered to by Applicant are given in R. Mills, The Grand Unified Theory of Classical Quantum Mechanics, September 2001 Edition, Introduction section. None of these principles are part of quantum mechanics— only postulates which are in counter to these laws.

The Secret Committee states that the Schrodinger equation is a wave equation with a wavefunction solution that is interpreted in probabilistic terms; thus, it must follow first principles. In actuality it is not a correct wave equation since it gives the velocity squared proportional to the frequency. It is also not relativistically invariant and is in violation of Maxwell's equations which are relativistically invariant.[110] The Committee's interpretation of the wavefunction has many difficulties which are manifest when the specifics regarding "interpreted in probabilistic terms" are demanded. According to quantum mechanics, the electron of the hydrogen atom has an infinite number of positions and energies SIMULTANEOUSLY—even those with infinite negative kinetic energy. Measurement collapses the wavefunction into a definite. This fundamental tenant of quantum mechanics and the inherent Heisenberg Uncertainty principles have nothing to do with probability theory .[111] The inescapable failings of the Schrodinger equation regarding its consequences, physical laws, and experimental

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[108] References 2 and 3.

[109] Reference 39 at Chapter 37.

[110] References 32, 45 and 39 at Forward and Introduction section, and Chapters 35-38.

[111] Reference 32.

observations have already been pointed out .[112]

5.   Applicant's response to the Secret Committee's contention that "Applicant's use of a classical wave equation to describe quantum mechanical phenomena is incorrect"

Applicant's use of the wave equation is definitely mathematically correct. See Equations (1.1), (1.48), and (1.49) in Chapter 1 of R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc.   In fact, this wave equation is the same form that is used in quantum mechanical textbooks to solve the rigid rotor problem.[113] Differential equations akin to this wave equation have been used as tools since the 1600's for many applications and are not unique to Quantum Theory.

Applicant's theory departs from Quantum Theory by invoking nonradiation as the constraints on the wave equation to solve the one electron atom; whereas, the boundary condition for the solution of the wavefunction of the hydrogen atom with the Schrödinger equation is that $\Psi \to 0$ as $r \to \infty$ which is purely mathematical .[114] See pages 1-43 for a complete summary of Applicant's theory. See also pages 45-63 for a description of how Applicant's solves the wave equation.

6. Applicant's response to the Secret Committee's contention that "Applicant's use of a boundary condition, based on a paper by Haus is unjustified"

The application of Haus's condition of nonradiation is completely valid and the disregard of Maxwell's equations is the primary failing point of quantum mechanics.   The Secret Committee argues that it is improper to apply Maxwell's' equations to the electron bound in an

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[112] References 32, 45 and 39 at Forward and Introduction sections, and Chapters 35-38.

[113] Reference 39 and the rigid rotor wave equations given by McQuarrie in Reference 65 at pages 206-221.

[114] Reference 39 at Chapter 1.

atom. On what basis does the Committee offer that Maxwell's equation should not apply other than the postulates of quantum mechanics with the implicit consequences that the wavefunctions do not obey physical laws? The Secret Committee makes the mistake that started with Bohr—the electron must be a point, and by Maxwell's equations, the electron must radiate and fall into the nucleus since it is accelerating. Acceleration without radiation is possible in full compliance with Maxwell's equations as shown by Applicant's use of Haus's condition.

Haus's condition is fully applicable to a superposition of charge since Maxwell's equations obey superposition. As a further proof that Applicant is correct on this point, he has solved the radiation fields on Applicant's electron in the far field based on the Poynting power vector and has shown that there is no radiation. From R. Mills, The Grand Unified Theory of Classical Quantum Mechanics, September 2001 Edition, Appendix I: Nonradiation Based on the Electromagnetic Fields and the Poynting Power Vector, p. 110:

A point charge undergoing periodic motion accelerates and as a consequence radiates according to the Larmor formula:

$$P = \frac{1}{4\pi\varepsilon_0} \frac{2e^2}{3c^3} a^2 \qquad (1)$$

where e is the charge, a is its acceleration, ε_0 is the permittivity of free space, and C is the speed of light. Although an accelerated *point* particle radiates, an *extended distribution* modeled as a superposition of accelerating charges does not have to radiate. An ensemble of charges, all oscillating at the same frequency, create a radiation pattern with a number of nodes. The same applies to current patterns in phased array antenna design [34]. It is possible to have an ensemble of charges oscillating in such as way as to cause destructive interference or nodes in all directions. In order to obtain the condition, if it exists, that the electron current distribution given by Eq. (11) must satisfy such that the electron does not radiate, the electromagnetic far field is determined from the current distribution.

Although an accelerated *point* particle radiates, an *extended distribution* modeled as a superposition of accelerating charges does not have to radiate. Others have shown that with an ensemble of charge, acceleration is possible without radiation.[115]

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[115] References 70-73.

Regarding the internal structure of Applicant's solution of the electron, Applicant calculates the electron g factor in closed form from Maxwell's equations and achieves a remarkable 11 figure agreement with the experimentally observed value. [116]

Regarding the Secret Committee's position that it has not been shown that the electron has a constant velocity, it has been shown that the hydrogen atom's electron has a constant binding energy of 13.59844 eV, a constant angular momentum of $\hbar$ known to better than 9 significant figures, a magnetic moment of a Bohr magneton known to better than 8 significant figures, and an electron g factor known to better that 11 figures. First principle laws require that the velocity must be constant as given by Applicant . [117]

Remarkably, the uncertainty in the electron speed according to the uncertainty principle is $1.4 \, X \, 10^7 \, m/sec$ which is an order of magnitude larger that the speed. [118] It is also ironic that the Secret Committee's position is that a valid theory can not permit the electron to "spiral into the nucleus" when in fact the wave function solution of the Schrodinger equation require that the electron IS IN THE NUCLEUS.[119] The Committee has still not responded to this inescapable fact of quantum mechanics that is clearly claimed in the literature as discussed in Section 17 of this Response.

The Secret Committee states on page 14 of the Attachment to the Final Office Action that:

Applicant's use of a boundary condition, based on a paper by Haus entitled "On

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[116]Reference 39 at Chapter 1.

[117] Reference 39 at Chapter 1.

[118] Reference 65 at page 38.

[119] Reference 32.

the radiation from point charges," is unjustified. In order to place applicant's argument in proper persepective, it is noted that from a purely classical point of view an accelerated charge radiates energy. ... If one were to extend this argument to an electron in a hydrogen atom whose nucleus consists of a single proton, then, *classically speaking,* one would expect the electron to continuously radiate away energy as it spirals towards and eventually collapses into the positively charged nucleus. So classically speaking again, the hydrogen atom cannot exist. Reality, however, dictates otherwise – hydrogen atoms clearly exist. **Their spectra have been measured**. What, then, is the explanation for the stability of the hydrogen atom? *Clearly, using classical concepts to describe a hydrogen atom leads to unrealistic conclusions such as the collapse of the atom.* [Emphasis added]

First, Applicant's theory correctly solves the hydrogen atom based on classical concepts as an extended particle, not a point particle as wrongly suggested by the Secret Committee. Thus, the Committees comments regarding the problems of classical concepts based on a point particle are irrelevant. The Committee's continued mischaracterization of Applicant's theory cannot be considered a mere oversight, and shows a definite pattern of improper subversion.

Second, Applicant's theory does not predict that the electron will collapse into the nucleus, rather in contrast to the Schrodinger equation, it is derived using the experimentally observed constraint that the n=1 state is nonradiative. The correct solution of the hydrogen atom is based on Maxwell's equations and further predicts that lower-energy states exist which are non-radiative and require the presence of catalyst to obtain them. Indeed, two pages later in the Attachment, the Secret Committee admits that Applicant's theory predicts that the lower-energy hydrogen atom is stable, i.e. the electron does not collapse into the nucleus. [page 16 of the Attachment, "Applicant's explanation for the stability of the "hydino atom"... (emphasis added)] Even more shocking is that Quantum Theory relied upon by the Secret Comittee requires that the electron be in the nucleus, not merely spirally down to the nucleus, as shown by Karpus.[120] Thus, the Secret Committee should be complaining about the shortcomings of Quantum Theory, instead of Applicant's theory.

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[120] Reference 77.

Third, Applicant has provided extensive **spectra** showing the new lower-energy states, which the Secret Committee has flat out ignored. Yet, the Committee has no problem citing spectra to make their point about the physical presence of hydrogen atoms. Applicant demands that the Committee fully consider Appilicant's spectra (spectroscopic evidence) that shows the physical presence of lower-energy hydrogen, in the same manner conventional hydrogen has been shown by its spectra.

The Secret Committee argues on page 15, last paragraph, in the Attachment to the Final Office Action that:

> (ii) Haus's paper is relevant to a *free electron laser* whereas applicant's theory is concerned with an *atom where the electron is not a free electron*. That is, in Haus's paper there is no proton exerting a Coulomb force on an electron as in the case of the hydrogen atom. These issues were previously raised by the [Secret Committee] on p. 4 of the Appendix attached to the previous office action but have *yet* to receive a satisfactory reply from the applicant. Since the two areas of application (free electron laser and hydrogen atom) are *prima facie* different and constitute, in essence, *non-analogous art*, once again it is evident that Haus's boundary condition which was used in the context of a free electron laser cannot be bodily incorporated into a theory of the hydrogen atom without leading to scientifically unaccepatable results.

Applicant has already fully responded to this argument in their previous Response by showing through extensive experimental results that Applicant's theory does <u>not</u> provide "scientifically unacceptable results" as alleged by the Secret Committee, but rather predicts the very same lower-energy hydrogen that Applicant's experimental results verify. Thus, Applicant's theory provides scientifically accurate and acceptable results. Simply put, the experimental results verify Applicant's theory and disproves the Secret Committees understanding of conventional Quantum Theory. Lower-energy hydrogen exists, whether the Secret Committee likes it or not.

7. Applicant's response to the Secret Committee's contention that "Applicant's explanation for the stability of the hydrino atom is unpersuasive"

The Secret Committee states on pages 16 and 17 of the Attachment to the Final Office Action that:

> The Examiner has previously raised the issue of the implosion or lack of stability of the "hydrino atom" on p.4 of the Appendix to the previous office action. In his response, on pp. 57-88 of the amendment, the applicant refers to "conservation of energy" as shown in Chapter 5 of his book as accounting for the alleged stability of the "hydrino atom." The examiner has consulted Chapter 5, pp. 138-161, in the book but finds the issue to be as yet *unresolved*. Thus, pp. 138-159 deal essentially with a catalytic system based on tapping into alleged energy states of the "hydrino atom" and do not come to grips with the issue of the instability of the "hydrino atom" in the first place. Page 160 indicates that "[h]ydrogen atoms can undergo transitions to energy states below the ground state until the total potential energy of the *proton* is converted to relativistically corrected kinetic energy and total energy." Emphasis added. However, it is not understood as to what the potential energy of the *proton* has to do with the energy of an *electron*, especially, when the issues of interest are the energy states of the electron. Moreover, since the total energy *is* the sum of the potential and kinetic energies, no meaning can be ascribed to applicant's statement that the potential energy is converted *inter alia* total energy. It appears that applicant has given a *confusing* and *conclusory* statement that alleges that something *can* happen as opposed to just what does happen. It is evident that applicant's response regarding the lack of stability of the "hydrino atom" is clearly unpersuasive.

This issue is not unresolved as alleged by the Secret Committee. Applicant's theory clearly teaches how the hydrino atom is stable, and the extensive experimental evidence of record supports his theory by conclusively demonstrating these stable lower-energy states. Nevertheless, Applicant will once again respond.

The rigorous derivations from Maxwell's equations of the stability of the $n = $ integer and $n = 1/$ integer states of atomic hydrogen are given in the Stability of Atoms and Hydrinos section of Applicant's publications .[121]   The lowest-energy-state hydrino according to Maxwell's

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[121] Reference 39 at Chapter 6.

equations is given in the New "Ground" State section of Applicant's publications .[122] Contrary to the assertion of the Secret Committee, the Hydrinos are stable according to Maxwell's equations as demonstrated by Applicant. They are further shown to be experimentally stable since they exist in novel compounds as summarized in Section I of this Response.

It is surprising to Applicant that the Secret Committee does not know that the total energy is a term of art in quantum mechanics which refers to the sum of the potential energy due to the field of the proton and the kinetic energy of the electron and is equal in magnitude to the binding energy of the electron. On page 24 of McQuarrie appears, "The total energy of the electron is equal to the sum of its kinetic energy and potential energy" which arises to the Coulomb field of the electron.[123] The potential energy due to the proton's field is not infinite, as predicted by Quantum Theory, the maximum potential energy corresponds to the finite radius of the nucleus. Applicant gives the lowest energy state possible described in the "New Ground State" section.[124]

The n = 1 solution of the Schrodinger equation is by DEFINITION-NOT BY PHYSICS. No physical basis is put forward to explain why the electron is stable in the hydrogen atom. In fact, quantum mechanics is purely postulated—not based on directly testable physical laws—only distortions of corresponding properties of these laws embodied as "operators". Such arbitrary creations include Hund's Rule, color conservation, flavor conservation, spin of fermions and bosons, parity, the Pauli Exclusion Principle, and the Schrodinger equation with its definition of the "ground state" solution of the hydrogen atom. As discussed in Section 3 of this Response, since the Schrodinger equation is not based on physical laws it predicts a continuum of states. Thus, the "ground state" definition is essential for the Schrodinger equation to match the experimental Rydberg series. Applicant should not be prejudiced by the Secret Committee's recalcitrance to admit this fact of the Schrodinger equation. And, even with this definition, the

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[122] Reference 39 at Chapter 5.

[123] Reference 65 at page 24.

[124] Reference 39 at Chapter 5.

Schrodinger solution fails. For example, the Schrödinger equation solution must radiate according to Maxwell's equations. [125]

Feynman's derivation of the Bohr radius based on the Uncertainty Principle is flawed on the basis of the at least five points shown by Applicant.[126] And, the experimentally confirmed shortcomings of the Schrödinger equation and Dirac equations are also addressed in the Sections I, 2-4, 6, 14, and 17 of this Response.

The hydrogen atom derived by Applicant from first principles matches the hydrogen spectrum including the Lamb shift. It succeeds were quantum mechanics has failed .[127] Some of its astonishing successes are summarized in the following except from R. Mills, The Grand Unified Theory of Classical Quantum Mechanics, September 2001 Edition, Introduction; also see the Forward section, pp. 34-35:

> The novel theory of Classical Quantum Mechanics (CQM) unifies Maxwell's Equations, Newton's Laws, and General and Special Relativity. The closed form calculations of a broad spectrum of fundamental phenomena containing fundamental constants only are given in subsequent sections. CQM gives closed form solutions for the atom which give four quantum numbers, the Rydberg constant, the stability of the $n = 1$ state and the instability of the excited states, relativistic invariance of the wave equation, the equation of the photon and electron in excited states, the equation of the free electron, and photon which predict the wave particle duality behavior of particles and light. The current and charge density functions of the electron may be directly physically interpreted. For example, spin angular momentum results from the motion of negatively charged mass moving systematically, and the equation for angular momentum, $\mathbf{r} \times \mathbf{p} = \hbar$, can be applied directly to the wave function (a current density function) that describes the electron. The magnetic moment of a Bohr magneton, Stern Gerlach experiment, electron and muon g factors, Lamb shift, resonant line width and shape, selection rules, correspondence principle, wave particle duality, excited

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[125] See The POSTULATED Schrodinger Equation Does Not Explain the Stability of the Hydrogen Atom section of Reference 32 and Chapter 35 of Reference 39.

[126] Reference 32.

[127] Reference 32.

states, reduced mass, rotational energies and momenta, spin-orbital coupling, Knight shift and spin-nuclear coupling, closed form solutions for one, two, and three electron atoms, excited states of the helium atom, elastic electron scattering from helium atoms, proton scattering from atomic hydrogen, the nature of the chemical bond, bond energies, vibrational energies, rotational energies, and bond distances of hydrogen-type molecules and molecular ions, Davisson Germer experiment, Aspect experiment, Durr experiment on the Heisenberg Uncertainty Principle, Penning trap experiments on single ions, hyperfine structure interval of positronium, magnetic moments of the nucleons, beta decay energy of the neutron, the binding energy of deuterium, and alpha decay are derived in closed form equations based on Maxwell's equations. The theory of collective phenomena including statistical mechanics, superconductivity and Josephson junction experiments, integral and fractional quantum Hall effects, and the Aharonov-Bohm effect is given. The calculations agree with experimental observations.

From the closed form solution of the helium atom, the predicted electron scattering intensity is derived. The closed form scattering equation matches the experimental data; whereas, calculations based on the Born model of the atom utterly fail at small scattering angles. The implications for the invalidity of the Schrödinger and Born model of the atom and the dependent Heisenberg Uncertainty Principle are discussed.

For any kind of wave advancing with limiting velocity and capable of transmitting signals, the equation of front propagation is the same as the equation for the front of a light wave. By applying this condition to electromagnetic and gravitational fields at particle production, the Schwarzschild metric (SM) is derived from the classical wave equation which modifies general relativity to include conservation of spacetime in addition to momentum and matter/energy. The result gives a natural relationship between Maxwell's equations, special relativity, and general relativity. It gives gravitation from the atom to the cosmos. The gravitational equations with the equivalence of the particle production energies permit the equivalence of mass/energy and the spacetime wherein a *"clock" is defined that measures "clicks" on an observable in one aspect, and in another, it is the ruler of spacetime of the universe with the implicit dependence of spacetime on matter-energy conversion.* The masses of the leptons, the quarks, and nucleons are derived from this metric of spacetime. The universe is time harmonically oscillatory in matter, energy, and spacetime expansion and contraction with a minimum radius that is the gravitational radius. In closed form equations with fundamental constants only, CQM gives the basis of the atomic, thermodynamic, and cosmological arrows of time, the deflection of light by stars, the precession of the perihelion of Mercury, the Hubble constant, the age of the universe, the observed acceleration of the expansion, the power of the universe, the power spectrum of the universe, the microwave background temperature, the uniformity of the microwave background radiation, the microkelvin spatial

variation of the microwave background radiation measured by DASI, the observed violation of the GZK cutoff, the mass density of the universe, the large scale structure of the universe, and the identity of dark matter which matches the criteria for the structure of galaxies and spectral lines from interstellar medium and the Sun which have been observed in the laboratory [25-26]. In a special case wherein the gravitational potential energy density of a blackhole equals that of the Planck mass, matter converts to energy and spacetime expands with the release of a gamma ray burst. The singularity in the SM is eliminated.[128]

The Secret Committee states on pages 17 and 18 of the Attachment to the Final Office Action that:

> The *lowest* energy state occupied by the electron is known as the *ground state* and is characterized by the quantum numbers $n = 1$ and $l = 0$. It stands to reason that there cannot be any state lower than, i.e. below, the ground state. Therefore, applicant's statement that "[h]ydrogen atoms can undergo transitions to energy states below the ground state" on p. 160 of his book is incorrect. While occupying a stationary state the electron does not radiate energy. That is why the hydrogen atom does not collapse – just as nature has it. There is no need at all to invoke extraneous equations and borrow special boundary conditions *since the Schrodinger equation is the proper equation, within a non-relativistic spin-free framework, describing the behavior of the electron and suffices to answer scientifically meaningful questions about the quantum energy levels of the electron.*

This statement by the Secret Committee is completely devoid of logic and is but one more example of this Committee's oversimplistic analysis. Using this analysis, there could never be an improvement patent that was contrary to what was previously known.

Secondly, Applicant has never claimed that hydrogen can go to the new lower-energy states by emission of radiation by itself. Applicant unambiguously has stated that a catalyst is required! There must be a **non-radiative** transfer of energy from the hydrogen atom to the catalyst. Thus, either the Secret Committee is purposely mischaracterizing Applicant's technology or it's members lack even fundamental knowledge of quantum principles.

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[128] References 27 and 39.

8. Applicant's response to the Secret Committee's contention that "Applicant's use of classical electromagnetic theory in the context of the hydrogen atom is incorrect"

Applicant has shown that Maxwell's equations are fully applicable in describing up to 11-figure accuracy observations on the atom and the electron.[129] The quantum nature of electromagnetic radiation arises naturally as shown from the following excerpt from R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", *Int. J. Hydrogen Energy*, in press:

CQM gives closed form solutions for the resonant photons and excited state electron functions. The angular momentum of the photon given by

$$\mathbf{m} = \frac{1}{8\pi} \text{Re}[\mathbf{r} \times (\mathbf{E} \times \mathbf{B}^*)] = \hbar \qquad (43)$$

is conserved [7]. The change in angular velocity of the electron is equal to the angular frequency of the resonant photon. The energy is given by Planck's equation. The predicted energies, Lamb shift, hyperfine structure, resonant line shape, line width, selection rules, etc. are in agreement with observation.

The orbitsphere is a dynamic spherical resonator cavity which traps photons of discrete frequencies. The relationship between an allowed radius and the "photon standing wave" wavelength is

$$2\pi r = n\lambda \qquad (44)$$

where n is an integer. The relationship between an allowed radius and the electron wavelength is

$$2\pi(nr_1) = 2\pi r_n = n\lambda_1 = \lambda_n \qquad (45)$$

where $n = 1,2,3,4,....$. The radius of an orbitsphere increases with the absorption of electromagnetic energy. The radii of excited states are solved using the electromagnetic force equations of Maxwell relating the field from the charge of the proton, the electric field of the photon, and charge and mass density functions of the electron wherein the angular momentum of the electron is given by Planck's constant bar (Eq. (37)). The solutions to Maxwell's equations for modes that can be excited in the orbitsphere resonator cavity give rise to four quantum numbers, and the energies of the modes are the experimentally known hydrogen spectrum. The relationship between the electric field equation and the "trapped photon" source charge-density function is given by Maxwell's equation in two dimensions.

$$\mathbf{n} \cdot (\mathbf{E}_1 - \mathbf{E}_2) = \frac{\sigma}{\varepsilon_0} \qquad (46)$$

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[129] Reference 39 at Chapters 1-2 and 4.

The photon standing electromagnetic wave is phase matched with the electron

$$\mathbf{E}_{r\,photon\,n,l,m} = \frac{e(na_H)^{\ell}}{4\pi\varepsilon_o}\frac{1}{r^{(\ell+2)}}\left[-Y_0^0(\theta,\phi)+\frac{1}{n}\left[Y_0^0(\theta,\phi)+\mathrm{Re}\left\{Y_\ell^m(\theta,\phi)\left[1+e^{i\omega_n t}\right]\right\}\right]\right]\delta(r-r_n) \quad (47)$$

$$\omega_n = 0 \;\; for \; m = 0$$

$$\ell = 1,2,\dots,n-1$$

$$m = -\ell, -\ell+1,\dots,0,\dots,+\ell$$

$$\mathbf{E}_{r\,total} = \frac{e}{4\pi\varepsilon_o r^2} + \frac{e(na_H)^{\ell}}{4\pi\varepsilon_o}\frac{1}{r^{(\ell+2)}}\left[-Y_0^0(\theta,\phi)+\frac{1}{n}\left[Y_0^0(\theta,\phi)+\mathrm{Re}\left\{Y_\ell^m(\theta,\phi)\left[1+e^{i\omega_n t}\right]\right\}\right]\right]\delta(r-r_n)$$

$$(48)$$

$$\omega_n = 0 \; for \; m = 0$$

For $r = na_H$ and $m = 0$, the total radial electric field is

$$\mathbf{E}_{r\,total} = \frac{1}{n}\frac{e}{4\pi\varepsilon_o(na_H)^2} \quad (49)$$

The energy of the photon which excites a mode in the electron spherical resonator cavity from radius a_H to radius na_H is

$$E_{photon} = \frac{e^2}{8\pi\varepsilon_o a_H}\left[1-\frac{1}{n^2}\right] = h\nu = \hbar\omega \quad (50)$$

The change in angular velocity of the orbitsphere for an excitation from $n = 1$ to $n = n$ is

$$\Delta\omega = \frac{\hbar}{m_e(a_H)^2} - \frac{\hbar}{m_e(na_H)^2} = \frac{\hbar}{m_e(a_H)^2}\left[1-\frac{1}{n^2}\right] \quad (51)$$

The kinetic energy change of the transition is

$$\frac{1}{2}m_e(\Delta v)^2 = \frac{e^2}{8\pi\varepsilon_0 a_H}\left[1-\frac{1}{n^2}\right] = \hbar\omega \quad (52)$$

The change in angular velocity of the electron orbitsphere is identical to the angular velocity of the photon necessary for the excitation, ω_{photon}. The *correspondence principle holds*. It can be demonstrated that the resonance condition between these frequencies is to be satisfied in order to have a net change of the energy field [8].[130]

9. Applicant's response to the Secret Committee's contention that "Applicant's derivation of the energy states of the hydrino atom has no basis"

On page 20 of the Attachment to the Final Office Action, the Secret Committee argues

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[130] Reference 39 at Chapter 2 and Chapter 4, which teaches that the Equation of the photon based on Maxwell's equations is consistent with experimental measurements on the photon including quantization of energy and the wave-particle duality.

that:

> Applicant's derivation of energy states of the "hydrino atom" which are characterized by *fractional* quantum numbers (1/n, where n=2, 3, ...) has *no proper scientific or mathematical basis*. The examiner has raised this issue in the previous office action. The present amendment does *not* respond to this other than to set forth a *conclusory* statement that makes *no mention of the details* of the mathematical steps and the scientific basis for obtaining such improper fractional quantum numbers. See p. 60 of the amendment. Given the applicant's silence on this crucial issue, the examiner referred to applicant's book, in attachment 16, to again find only conclusory statements. As evidence, pp. 20, 83 and 147 in the book are cited.

This simply is not true. Applicant clearly provided a sound basis for the derivation of the energy states based upon Maxwell's equations. The solutions found by Applicant not mere conclusions, since they predict precise lower-energy states of the hydrogen atom. Applicant further pointed out that the extensive experimental evidence of record conclusively confirms these precise lower-energy states that were predicted by Applicant's solutions. In contrast, it is the Secret Committee that relies upon mere conclusions to support its position, instead of sound real-world experimental evidence.

One again, the deviation of the hydrino states (lower-energy states) is rigorously given as a solution of Maxwell's equations. The states are given by Eq. (5.13) .[131]

In addition to providing a rigorous theoretical derivation which is not required by Patent Law, Applicant's data proves lower-energy hydrogen states as shown in Section I of this Response. THESE LOWER-ENERGY STATES HAVE BEEN CONFIRMED SPECTROSCOPICALLY MAKING THE SECRET COMMITTEE'S THEORETICAL ARGUMENT MUTE. See the extensive spectroscopic experimental evidence discussed at Section 1 of this response. THAT DATA SHOWS THAT THE n =1/integer MUST BE ACCOUNTED FOR BY A VALID THEORY OF THE HYDROGEN ATOM. THEORIES DO

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[131] Reference 39 at Chapters 2, 5, and 6.

NOT INVALIDATE DATA -- DATA INVALIDATES OR VALIDATES THEORIES.

The Secret Committee argues that the parameter $n = 1/\text{integer}$ for the **arbitrary constant** in the Laguerre differential equation gives rise to an infinite series solution; thus, it is not a solution of the Schrödinger equation. This position is erroneous. Many differential equation have infinite series solutions.[132] In fact, the most common functions such as the sine, cosine, experiential, Bessel, Neumann, and Hankel functions are infinite series. Furthermore, the Secret Committee's argument is internally inconsistent since it insists that the solution must not be an infinite sequence. Whereas, the Schrödinger Laguerre wavefunctions given by $R_{n,\ell} = c_{n,\ell} e^{-x/2} x^{\ell} L_{n+\ell}^{2\ell+1}(x)$ contain the exponential function which is the infinite sequence given by [133]

$$e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!}$$

Furthermore, Margenau and Murphy do not imply that the series solution to the Schrodinger equation is any less valid than the one that gives a polynomial.[134] The Secret Committee takes the search for a meaningful solution to the Schrödinger equation out of context from the pure mathematics. The avoidance of a series solution is not mentioned in the determination of the Schrödinger equation solutions by Margenau and Murphy.[135] They use the experimental energy levels of the hydrogen atom as their motivation for selection of a set from the infinite possibilities. Even here, they admit that the solution for the highly excited states and the continuum states are sinusoidal over all space and are not integrable.[136] Thus, they are infinite and nonsensical—in violation of the Secret Committee's position that they must vanish at

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[132] Reference 56.

[133] Reference 56.

[134] Reference 57.

[135] Reference 57.

[136] Reference 57.

infinity. In addition, the sinusoid is a function comprising an infinite sequence, specifically:[137]

$$\sin x = \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n+1}}{(2n+1)!}$$

In the case that the parameter $n = 1/\text{integer}$ is chosen for the **arbitrary constant** in the Laguerre differential equation, the solution for the energy is the equally valid result:[138]

$$W_n = -E_n = \frac{1}{2} \frac{me^4}{\left(\dfrac{1}{p}\right)^2 \hbar^2}$$

These arguments demonstrate what is known by physicists: the only justification for the series $n = \text{integer}$ stating with one is that it matches the experimental data. Applicant's data showing lower-energy hydrogen atoms demands that theory be modified or replaced. Furthermore, Applicant's theory derived from first principles does not encounter these problems. It is completely consistent with all energy states of the hydrogen atom including the continuum states.[139] And, the lower-energy hydrogen states, now confirmed experimentally, were predicted.[140]

10. Applicant's response to the Secret Committee's contention that "Applicant's use of a Dirac delta function to represent a charge density function is incorrect"

The Secret Committee is simply wrong in its allegation that Applicant's use of the Dirac delta function is wrong. The Dirac delta function $\delta(r)$ can represent a point in spherical

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[137] Reference 56 at page 268.

[138] Reference 32.

[139] Reference 39 at Chapters 1-6.

[140] Reference 39 at Chapters 5, 7, and 12.

coordinates, and a Dirac delta function $f(r) = \frac{1}{r^2}\delta(r - r_n)$ can be defined to represent a spherical shell as is done by Applicant. [141] This convention is shown in Jackson.[142] Applicant also fully responded to this argument in his previous response.

11. Applicant's response to the Secret Committee's contention that "Applicant's theory predicts irreproducible phenomena, such as "cold fusion" just as equally well as the hydrino atom"

Applicant is not claiming cold fusion. Rather, novel compositions of matter are claimed which are experimentally confirmed as summarized in Section I of this Response. The cold fusion issue of Applicant's theory is discussed in Section 1 of this Response and is irrelevant to the prosecution of novel chemical compounds.

The Secret Committee improperly distorts the disclosure of Applicant's paper, R. Mills and S. Kneizys, Fusion Technol. Vol. 20, 65 (1991). A *decade ago*, Applicant presented experimental data that heat was observed with the combination of a predicted catalyst and atomic hydrogen produced by electrolysis. This data stands independently of fusion and is not claimed as fusion. Considering the scientific integrity and capability of other independent scientists reporting that heat was involved in certain electrolysis reactions, the authors present a case that novel chemical reactions should be considered rather than fusion as the source of the heat. From this paper:
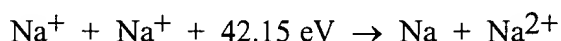
> DISCUSSION
> The data clearly indicate that excess heat was generated. Once the technique was perfected, each experiment using potassium carbonate produced excess heat. Some experiments were permitted to operate for weeks, and the excess heat remained relatively constant. What is the source of this excess enthalpy? Electrochemical reactions which consume the electrolyte can be ruled

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[141] Reference 39 at Chapter 1.

[142] Reference 74 at page 111.

out because any proposed electrochemical reactant would be completely consumed over the duration of these experiments. Nickel forms a hydride during cathodic electrolysis, but this process is endothermic [11]. The weight of the nickel cathode was unchanged by use in a heat producing cell to within one hundred thousandth of a gram (the cathode was rinsed after 36 hours of operation, and dried and degassed in vacuum before the final weight was determined). The only remaining candidates are heat releasing reactions involving the electrolytically generated hydrogen or oxygen atoms or molecules. Because the excess enthalpy exceeds that which can be accounted for due to complete recombination, new processes must be sought.

The results are consistent with the release of heat energy from hydrogen atoms where the K^+/K^+ electrocatalytic couple induces the electrons of hydrogen atoms to relax to a quantized potential energy level below that of the "ground" state by providing a redox energy-energy hole (27.28 eV) resonant with this transition. The balanced reaction is given by Equations 4.13-4.14 and Equation 4.8. Excess heat was also measured when K_2CO_3 was replaced by Rb_2CO_3 (manuscript in preparation). The Rb^+ ion (Energy hole from the second ionization is 27.28 eV) alone is electrocatalytic according to the reaction given by Equations 4.9-4.10 and Equation 4.8. No excess heat was observed when K_2CO_3 was replaced by Na_2CO_3 as demonstrated with Na_2CO_3 #18-Na_2CO_3 #18A and Na_2CO_3 #19-Na_2CO_3 #19A shown in Figures 8 and 9, respectively. For sodium or sodium ions no electrocatalytic reaction of approximately 27.21 eV is possible. For example, 42.15 eV of energy is absorbed by the reverse of the reaction given in Equation 4.14 where Na^+ replaces K^+ :

$$Na^+ + Na^+ + 42.15\,eV \rightarrow Na + Na^{2+}$$

The independent replication of these heat results were published by Dr. Noninski.[143] Dr. Noninski of the Laboratory for Electrochemistry of Renewed Electrode-Solution Interface (LEPGER) successfully reproduced the results of Mills and Kneizys, as a visiting professor at Franklin and Marshall College.[144] A significant increase in temperature with every watt input, compared with the calibration experiment ($\approx 50\ ^\circ C\,/\,W$ versus $\approx 30\ ^\circ C\,/\,W$), was observed during the electrolysis of potassium carbonate. This effect was not observed when sodium

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[143] Reference 59.

[144] Reference 48.

carbonate was electrolyzed. No trivial explanation (in terms of chemical reactions, change in heat transfer properties, etc.) of this effect were found.

Furthermore, Applicant can experimentally prove that potassium serves as a catalyst to release heat, form lower-energy hydrogen, and produce novel compounds as shown by the extensive experimental data summarized in Section 1 of this Response. Specifically:

10.) the observation of characteristic emission from K^{3+} which confirmed the resonant nonradiative energy transfer of $3 \cdot 27.2 \ eV$ from atomic hydrogen to atomic K,[145]

11.) the spectroscopic observation of the predicted $H^-(1/4)$ ion of hydrogen catalysis by K catalyst at 110 nm corresponding to its predicted binding energy of 11.2 eV,[146]

14.) the high resolution visible spectroscopic observation from rt-plasmas and plasma electrolysis cells of the predicted $H^-(1/2)$ ion of hydrogen catalysis by each of K^+/K^+, Rb^+, Cs, and Ar^+ at 407 nm corresponding to its predicted binding energy of 3.05 eV,[147]

15.) the observation of $H^-(1/2)$, the hydride ion catalyst product of K^+/K^+ or Rb^+, by high resolution visible spectroscopy as a broad peak at 407.00 nm with a FWHM of 0.14 nm corresponding to its predicted binding energy of 3.0468 eV,[148]

16.) the observation that the high resolution visible plasma emission spectra in the region of 400.0 nm to 406.0 nm matched the predicted bound-free hyperfine structure lines E_{HF} of

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[145] Reference 22.

[146] References 7 and 22.

[147] References 2, 7, 10, 11, 17, 22, and 25.

[148] References 2 and 7.

$H^-(1/2)$ calculated from the electron g factor as $E_{HF} = j^2 3.0056 \, X \, 10^{-5} + 3.0575 \, eV$ (j is an integer) for $j = 1$ to $j = 37$ to within a 1 part per 10^5,[149]

17.) Rb^+ or $2K^+$ catalysts formed a plasma having strong VUV emission with a stationary inverted Lyman population and emission from $H^-(1/2)$ was observed at 4070.0 Å corresponding to its predicted binding energy of $3.0468 \, eV$ with its predicted bound-free hyperfine structure lines $E_{HF} = j^2 3.0056 \, X \, 10^{-5} + 3.0575 \, eV$ (j is an integer) that matched for $j = 1$ to $j = 37$ to within a 1 part per 10^5,[150]

27.) the observation of significant Balmer α line broadening of 17, 9, 11, 14, *and* 24 eV from rt-plasmas of incandescently heated hydrogen with K^+/K^+, Rb^+, cesium, strontium, and strontium with Ar^+ catalysts, respectively, wherein the results could not be explained by Stark or thermal broadening or electric field acceleration of charged species since the measured field of the incandescent heater was extremely weak, 1 V/cm, corresponding to a broadening of much less than 1 eV,[151]

28.) calorimetric measurement of excess power of 20 mW/cc on rt-plasmas formed by heating hydrogen with K^+/K^+ and Ar^+ as catalysts,[152]

33.) the differential scanning calorimetry (DSC) measurement of minimum heats of formation of *KHI* by the catalytic reaction of K with atomic hydrogen and *KI* that were over $-2000 \, kJ/mole \, H_2$ compared to the enthalpy of combustion of hydrogen of $-241.8 \, kJ/mole \, H_2$

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[149] References 2 and 7.

[150] Reference 2.

[151] Reference 10.

[152] Reference 10.

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34.) the isolation of novel hydrogen compounds as products of the reaction of atomic hydrogen with atoms and ions which formed an anomalous plasma as reported in the EUV studies ,[154]

36.) the isolation of novel inorganic hydride compounds such as $KH\,KHCO_3$ and KH following each of the electrolysis and plasma electrolysis of a K_2CO_3 electrolyte which comprised high binding energy hydride ions that were stable in water with their identification by methods such as (i) ToF-SIMS on $KH\,KHCO_3$ which showed inorganic hydride clusters $K[KH\,KHCO_3]_n^+$ and a negative ToF-SIMS dominated by hydride ion, (ii) X-ray photoelectron spectroscopy which showed novel peaks corresponding to high binding energy hydride ions, and (iii) proton nuclear magnetic resonance spectroscopy which showed upfield shifted peaks corresponding to more diamagnetic, high-binding-energy hydride ions,[155]

38.) the identification of novel hydride compounds by a number of analytic methods as such as (i) time of flight secondary ion mass spectroscopy which showed a dominant hydride ion in the negative ion spectrum, (ii) X-ray photoelectron spectroscopy which showed novel hydride peaks and significant shifts of the core levels of the primary elements bound to the novel hydride ions, (iii) ^1H nuclear magnetic resonance spectroscopy (NMR) which showed extraordinary upfield chemical shifts compared to the NMR of the corresponding ordinary hydrides, and iv.) thermal decomposition with analysis by gas chromatography, and mass spectroscopy which identified the compounds as hydrides, [156]

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[153] Reference 24.

[154] References 3, 4, 11, 24, 30, and 40-44.

[155] References 8, 11, 41, 43, and 44.

[156] References 8, 11, 41, and 43.

39.) the NMR identification of novel hydride compounds MH^*X wherein M is the alkali or alkaline earth metal, X, is a halide, and H^* comprises a novel high binding energy hydride ion identified by a large distinct upfield resonance [4, 24, 30, 40, 42],

40.) the replication of the NMR results of the identification of novel hydride compounds by large distinct upfield resonances at Spectral Data Services, University of Massachusetts Amherst, University of Delaware, Grace Davison, and National Research Council of Canada [Reference 30],

41.) the NMR identification of novel hydride compounds MH^* and MH_2^* wherein M is the alkali or alkaline earth metal and H^* comprises a novel high binding energy hydride ion identified by a large distinct upfield resonance that proves the hydride ion is different from the hydride ion of the corresponding known compound of the same composition [Reference 30].

12. Applicant's response to the Secret Committee's contention that "Applicant states that the Schrodinger equation does not predict cold fusion"

The Secret Committee again distorts the disclosure of Applicant's paper, R. Mills and S. Kneizys, Fusion Technol. Vol. 20, 65 (1991). A *decade ago*, Applicant presented experimental data that heat was observed with the combination of a predicted catalyst and atomic hydrogen produced by electrolysis. This data stands independently of fusion and is not claimed as fusion. The paper reported that heat was released that was due to a chemical reaction—not a nuclear reaction. It reported that researchers studying the phenomenon of heat release in electrolytic cells should consider this as the source of heat—not fusion.

This is made clear in the report cited by the Secret Committee in Section 21 of this Response. Quoting from page 1 of Peterson, S., H., Evaluation of Heat Production from Light Water Electrolysis Cells of HydroCatalysis Power Corporation, Report from Westinghouse STC,

1310 Beulah Road, Pittsburgh, PA, February 25, 1994:

> "HydroCatalysis Power Corporation (HPC) has developed electrolysis cells that are reported to produce excess power, as heat, during the electrolysis of a potassium carbonate electrolyte with a nickel cathode. This may be loosely associated with "Cold Fusion" although HPC claims an advanced quantum theory that provides a purely chemical explanation for the heat production."[157]

The success or failure of other researchers to achieve a reproducible reaction which produces heat is irrelevant. Furthermore, the PTO has not demonstrated that these other so-called attempts to reproduce Applicant's invention in fact followed Applicant's teachings.

The PTO should properly focus its examination on the experimental evidence presented by Applicant. Applicant has clearly demonstrated the novel reactions and compositions of matter by the many analytical methods described in Section 1, summarized as follows:

extreme ultraviolet (EUV) spectroscopy,

characteristic emission from catalysis and the hydride ion products,

lower-energy hydrogen emission,

plasma formation,

Balmer α line broadening,

elevated electron temperature,

anomalous plasma afterglow duration,

power generation, and

analysis of chemical compounds.

Modifications or replacement of the Schrodinger equation are indicated based on this data. Others have been able to repeat this effect as shown in the Attachments and the recent paper by Conrads.[158]

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[157] HPC is now BlackLight Power Corp. (BLP). Applicant is CEO and primary owner of BLP.

[158] Reference 1.

13. Applicant's response to the Secret Committee's "Response to the argument that those skilled in the art know that the Schrödinger equation does not represent physical reality"

The connection between quantum mechanics and reality is more than just "philosophical". It reveals that quantum mechanics is **not** a correct or complete theory of the physical world and that inescapable internal inconsistencies and incongruities with physical observation arise when attempts are made to treat it as a physical as opposed to a purely mathematical "tool." Some of these issues are discussed in a review by Laloë.[159] The flaw in the interpretation of Fuchs is discussed by Applicant.[160] The invalidity of quantum mechanics as a physical theory which describes reality is given in Section I of this Response. Moreover, a mere "theory," such as Quantum Theory, cannot be used to ignore real-world experimental evidence. Simply put, lower-energy hydrogen exists and the Secret Committee cannot hide behind a theory to ignore this fact.

14. Applicant's response to the Secret Committee's "Response to the argument that the Heisenberg Uncertainty Principle fails"

The Heisenberg Uncertainty Principle is not a law of nature. It is based on circular arguments that the electron is a probability wave requiring that the electron have multiple positions and energies including negative and infinite energies simultaneously. Both the Schrodinger equation and the implicit Heisenberg Uncertainty Principle are postulated, cannot be proven experimentally, and predict consequences such as violation of conservation of energy and momentum and an essentially infinite cosmological constant. These predictions are not in agreement with experimentation. Furthermore, it was recently proven experimentally that the Heisenberg Uncertainty principle has nothing to do with wave-particle duality;[161] whereas, the

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[159] Reference 60.

[160] Reference 32.

[161] References 32, 45 and 39 at Chapter 37.

opposite is largely touted as one of its triumphs. In contrast, the observable features of atomic particles such as the electron g factor may be calculated in closed form from Maxwell's equations with 11-figure accuracy without invoking the vagaries and inconsistencies inherent with the Heisenberg Uncertainty Principle. [162]

The Heisenberg Uncertainty Principle is further flawed since it predicts nonlocality, spooky actions at a distance, and perpetual motion which can be shown to be experimentally incorrect as given by Applicant .[163]

The Secret Committee cannot be serious in its contention that the Heisenberg Uncertainty Principle only applies to the double slit experiment and not the Durr experiment. Durr et al. experimentally disproved the widely held pillar of quantum mechanics taught in quantum textbooks that the Heisenberg Uncertainty Principle is the source of the wave-particle duality. The wave-particle duality is the central mystery of quantum mechanics—the one to which all others could ultimately be reduced. The validity of quantum mechanics is seriously challenged by this experimental result. The following excerpt [Ch. 37] covers the details of this issue and shows that the data of Durr et al. is predicted classically:

> The hydrogen atom is the only real problem for which the Schrödinger equation can be solved without approximations; however, it only provides three quantum numbers - not four. Nevertheless, the application of the Schrödinger equation to real problems has provided useful approximations for physicists and chemists. Schrödinger interpreted $e\Psi^*(x)\Psi(x)$ as the charge-density or the amount of charge between x and $x+dx$ (Ψ^* is the complex conjugate of Ψ). Presumably, then, he pictured the electron to be spread over large regions of space. Three years after Schrödinger's interpretation, Max Born, who was working with scattering theory, found that this interpretation led to inconsistencies and he replaced the Schrödinger interpretation with the probability of finding the electron between x and $x+dx$ as
>
> $$\int \Psi(x)\Psi^*(x)dx \qquad (37.2)$$

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[162] Reference 27.

[163] References 32 and 39 at Chapter 37.

Born's interpretation is generally accepted. Nonetheless, interpretation of the wave function is a never-ending source of confusion and conflict. Many scientists have solved this problem by conveniently adopting the Schrödinger interpretation for some problems and the Born interpretation for others. This duality allows the electron to be everywhere at one time—yet have no volume. Alternatively, the electron can be viewed as a discrete particle that moves here and there (from $r = 0$ to $r = \infty$), and $\Psi\Psi *$ gives the time average of this motion.

According to the quantum mechanical view, a moving particle is regarded as a wave group. To regard a moving particle as a wave group implies that there are fundamental limits to the accuracy with which such "particle" properties as position and momentum can be measured. Quantum predicts that the particle may be located anywhere within its wave group with a probability $|\Psi|^2$. An isolated wave group is the result of superposing an infinite number of waves with different wavelengths. The narrower the wave group, the greater range of wavelengths involved. A narrow de Broglie wave group thus means a well-defined position (Δx smaller) but a poorly defined wavelength and a large uncertainty Δp in the momentum of the particle the group represents. A wide wave group means a more precise momentum but a less precise position. The infamous Heisenberg Uncertainty Principle is a formal statement of the standard deviations of properties implicit in the probability model of fundamental particles.

$$\Delta x \Delta p \geq \frac{\hbar}{2} \tag{37.3}$$

According to the standard interpretation of quantum mechanics, the act of measuring the position or momentum of a quantum mechanical entity collapses the wave-particle duality because the principle forbids both quantities to be simultaneously known with precision.

THE WAVE-PARTICLE DUALITY IS NOT DUE TO THE UNCERTAINTY PRINCIPLE

Quantum entities can behave like particles or waves, depending on how they are observed. They can be diffracted and produce interference patterns (wave behavior) when they are allowed to take different paths from some source to a detector—in the usual example, electrons or photons go through two slits and form an interference pattern on the screen behind. On the other hand, with an appropriate detector put along one of the paths (at a slit, say), the quantum entities can be detected at a particular place and time, as if they are point-like particles. But any attempt to determine which path is taken by a quantum object destroys the interference pattern. Richard Feynman described this as the central mystery of quantum physics.

Bohr called this vague principle 'complementarity', and explained it in

terms of the uncertainty principle, put forward by Werner Heisenberg, his postdoc at the time. In an attempt to persuade Einstein that wave-particle duality is an essential part of quantum mechanics, Bohr constructed models of quantum measurements that showed the futility of trying to determine which path was taken by a quantum object in an interference experiment. As soon as enough information is acquired for this determination, the quantum interferences must vanish, said Bohr, because any act of observing will impart uncontrollable momentum kicks to the quantum object. This is quantified by Heisenberg's uncertainty principle, which relates uncertainty in positional information to uncertainty in momentum—when the position of an entity is constrained, the momentum must be randomized to a certain degree.

More than 60 years after the famous debate between Niels Bohr and Albert Einstein on the nature of quantum reality, a question central to their debate—the nature of quantum interference—has resurfaced. The usual textbook explanation of wave-particle duality in terms of unavoidable 'measurement disturbances' is experimentally proven incorrect by an experiment reported in the September 3, 1998 issue of *Nature* [5] by Durr, Nonn, and Rempe. **Durr, Nonn, and Rempe report on the interference fringes produced when a beam of cold atoms is diffracted by standing waves of light.** Their interferometer displayed fringes of high contrast—but when they manipulated the electronic state within the atoms with a microwave field according to which path was taken, the fringes disappeared entirely. The interferometer produced a spatial distribution of electronic populations which were observed via fluorescence. The microwave field canceled the spatial distribution of electronic populations. The key to this new experiment was that although the interferences are destroyed, the initially imposed atomic momentum distribution left an envelope pattern (in which the fringes used to reside) at the detector. A careful analysis of the pattern demonstrated that it had not been measurably distorted by a momentum kick of the type invoked by Bohr, and therefore that any locally realistic momentum kicks imparted by the manipulation of the internal atomic state according to the particular path of the atom are too small to be responsible for destroying interference.

Durr et al. conclude that the "Heisenberg Uncertainty relationship has nothing to do with wave-particle duality" and further conclude that the phenomenon is based on entanglement and correlation. Their interpretation of the principles of the experiment is that directional information is encoded by manipulating the internal state of an atom with a microwave field, which entangles the atom's momentum with its internal electronic state. Like all such entangled states, the constituent parts lose their separate identity. But the attachment of a distinguishable electronic label to each path means that the total electronic-plus-path wavefunction along one path becomes orthogonal to that along the other, and so the paths can't interfere. By encoding information as to

which path is taken within the atoms, the fringes disappear entirely. The internal labeling of paths does not even need to be read out to destroy the interferences: all you need is the option of being able to read it out.

According to Durr et al., the mere existence of information about an entity's path causes its wave nature to disappear. But, correlations are observations about relationships between quantities and do not cause physical processes to occur. **The existence of information about an entity's path is a consequence of the manipulation of the momentum states of the atoms which resulted in cancellation of the interference pattern. It was not the cause of the cancellation. The cancellation is predicted by the classical atomic theory of CQM.**

The explanation for the loss of interference in which-way experiments that endured and is present in essentially all quantum physics textbooks is that based on Heisenberg's position-momentum uncertainty relation. This has been illustrated in famous gedanken experiments like Einstein's recoiling slit [6] or Feynman's light microscope [7]. In the light microscope, electrons are illuminated with light immediately after they have passed through a double slit with slit separation d. A scattered photon localizes the electron with a position uncertainty of the order of the light wavelength, $\Delta z = \lambda_{light}$. Owing to Heisenberg's position-momentum uncertainty relation, this localization must produce a momentum uncertainty of the order of $\Delta p_z \approx h / \lambda_{light}$. This momentum uncertainty arises from the momentum kick transferred by the scattered photon. For $\lambda_{light} < d$, which-way information is obtained, but the momentum kick is so large that it completely washes out the spatial interference pattern.

The issue of whether momentum kicks are necessary to explain the two-slit experiment is revisited. Obviously, momentum is involved, because a diffraction pattern is a map of the momentum distribution in the experiment. But how is it involved? Is it everything, as Bohr would have claimed?

This is the question addressed by Durr et al. [5] who report on a which-way experiment with an atom interferometer wherein an incoming beam of atoms passes through two separated standing wave light beams. The detuning of the light frequency from the atomic resonance, $\Delta = \omega_{light} - \omega_{atom}$, is large so that spontaneous emission can be neglected. The light fields each create a conservative potential U for the atoms, the so-called light shift, with $U \propto I / \Delta$, where I is the light intensity. In a standing wave, the light intensity is a function of position

$$I(z) = I_0 \cos^2\left(k_{light} z\right) \tag{37.4}$$

where k_{light} is the wavevector of the light. Hence the light shift potential takes the
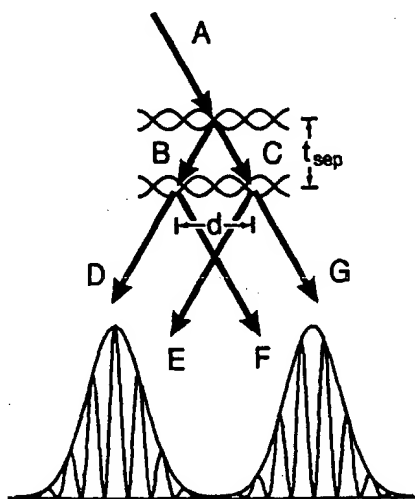
form

$$U(z) = U_0 \cos^2\left(k_{light}z\right) \tag{37.5}$$

with $U_0 \propto I_0 / \Delta$.

The atoms are Bragg-reflected from this periodic potential, if they enter the standing light wave at a Bragg angle. This process is similar to Bragg reflection of X-rays from the periodic structure of a solid-state crystal, but with the role of matter and light exchanged. The light creates the periodic structure, from which the matter wave is reflected.

The scheme of the interferometer is shown in Figure 37.5. The standing light wave splits the incoming atomic beam A into two beams, a transmitted beam C and a first-order Bragg-reflected beam B. The angle between the beams B and C corresponds to a momentum transfer of exactly $2\hbar k_{light}$ as determined by the spatial period of $U(z)$. By varying the light intensity, the fraction of reflected atoms can be adjusted to any arbitrary value. Durr et al. tune the reflectivity of the beam splitter to about 50%.

Figure 37.5. Scheme of the atom interferometer. The incoming atomic beam A is split into two beams: beam C is transmitted and beam B is Bragg-reflected from a standing light wave. The beams are not exactly vertical because a Bragg condition must be fulfilled. After free propagation for a time t_{sep}, the beams are displaced by a distance d. Then the beams are split again with a second standing light wave. In the far field, a spatial interference pattern is observed.

After switching off the first standing light wave, the two beams are

allowed to propagate freely for a time interval t_{sep}. During this time, beam B moves a horizontal distance $d / 2$ to the left, and beam C moves $d / 2$ to the right. The longitudinal velocities (direction normal to the standing light wave of Figure 37. 5) of the two beams are not affected by the light field. Then a second standing light wave is switched on, which also serves as a 50% beam splitter. Now two atomic beams D and E are traveling to the left, while beams F and G are traveling to the right. In the far field, each pair of overlapping beams produces a spatial interference pattern. The fringe period is the same as in a double-slit experiment with slit separation d as given in Two-Beam Interference section. The intensity is given by Eq. (8.22)

$$I(x) = 16a^2 C^2 \text{sinc}^2\left(\frac{2\pi ax}{\lambda f}\right)\cos^2\left(\frac{2\pi dx}{\lambda f}\right)$$

(37.6)

From Eq. (37.6), it is clear that the resulting pattern has the appearance of cosine^2 fringes of period $\lambda f / d$ with an envelope $\text{sinc}^2(2\pi ax / \lambda f)$ where and f is the focal length and a is the slit width. In the present case, the envelope of the fringe pattern is given by the collimation properties of the initial atomic beam A. Note that Eq. (37.6) corresponds to an amplitude transmission of a plane wave. The bound unpaired electron of each ^{85}Rb atom behaves as a plane wave of wavelength $\lambda = h / p$ as shown in the Free Electron section. The relevant wavelength λ of Eq. (37.6) is the de Broglie wavelength associated with the momentum of the atoms (Eq. (1.46)) which is transferred to the electrons through atomic interactions.

The atomic position distribution is observed by exciting atoms with a resonant laser and detecting the fluorescence photons. The observed far-field position distribution is a picture of the atomic transverse momentum distribution after the interaction. The pattern is given by Eq. (37.6). The pattern may be altered by application of microwave pulses which transfer momentum to the electrons of the ^{85}Rb atoms which add vectorally to that transferred from the interactions with the standing light field and atomic interactions.

Microwave pulses are now added to manipulate the two internal electronic states of the atom according to whether it moved along pathway B or C. A simplified level scheme of ^{85}Rb is shown in Figure 37.6. The manipulation of internal states by two microwave fields which each apply a $\pi / 2$ pulse is shown in Figure 37.7. Rabi oscillations between states $|2\rangle$ and $|3\rangle$ can be induced by applying a microwave field of about 3 GHz. To describe the manipulation of the two internal electronic states of the atom, we first investigate the properties of a single Bragg beam splitter.

Figure 37.6. Simplified level scheme of ^{85}Rb. The excited state $\left(5^2 P_{3/2}\right)$ is labeled $|e\rangle$. The ground state $\left(5^2 P_{1/2}\right)$ is split into two hyperfine states with

total angular momentum $F = 2$ and $F = 3$, which are labeled $|2\rangle$ and $|3\rangle$, respectively. The standing light wave has angular frequency ω_{light}.
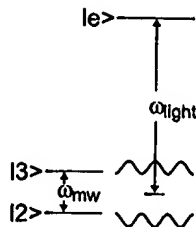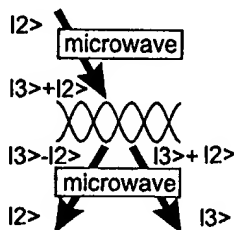

Figure 37.7. Scheme of the manipulation of internal states of ^{85}Rb by two microwave fields which each apply a $\pi / 2$ pulse. The standing light wave with angular frequency ω_{light} induces a light shift for both ground states which is given as a function of position. The beam splitter produces a phase shift that depends on the internal and external degree of freedom. A Ramsey scheme, consisting of two microwave $\pi / 2$ pulses, converts this phase shift into a population difference.

The frequency of the standing light wave, ω_{light} is tuned halfway between the $|2\rangle \rightarrow |e\rangle$ and $|3\rangle \rightarrow |e\rangle$ transitions. Hence the detunings from these transitions, Δ_{2e}, and Δ_{3e}, have the same absolute value but opposite sign. The reflectivity of the beam splitter, that is, the probability of reflecting an atom, depends on $t_{Bragg} \times |U_0|$, and it is independent of the internal state.

However, the amplitude of the wavefunction experiences a phase shift which depends on the internal atomic state. A simple analogy for this phase shift can be found in light optics: a light wave reflected from an optically thicker medium experiences a phase shift of π, while reflection from an optical thinner medium or transmission into an arbitrary medium does not cause any phase shift. This argument also applies in atomic optics: in the present experiment, an atom in $|2\rangle$ sees a negative light shift potential (because $\Delta_{2e} < 0$), corresponding to an optically thicker medium, while an atom in $|3\rangle$ sees a positive potential (because $\Delta_{3e} > 0$), corresponding to an optically thinner medium. Hence an atom will experience a π phase shift only if it is reflected in $|2\rangle$.

This phase shift can be converted into a population difference between the hyperfine levels. For that purpose, two microwave $\pi / 2$ pulses resonant with the hyperfine transition are applied. They form a Ramsey scheme as shown in Figure 37.7. The atom is initially prepared in state $|2\rangle$. Then a $\pi / 2$ microwave pulse is applied, converting the beam into an equal mixture of internal states of $|2\rangle + |3\rangle$. After this, each atom interacts with the standing light wave. As explained above, each atom will experience a π phase shift only if it is reflected and in state $|2\rangle$. Thus the internal state of the reflected beam is changed to an equal mixture of internal states of $|3\rangle - |2\rangle$, while the internal state of the transmitted beam is not affected. As a result, the momentum of each atom is a superposition of the internal and external degree of freedom of the atom which is specific to the path. The state vector of the system becomes:

$$|\psi\rangle \propto |\psi_B\rangle \otimes (|3\rangle - |2\rangle) + |\psi_C\rangle \otimes (|3\rangle + |2\rangle) \qquad (37.7)$$

where $|\psi_B\rangle$ and $|\psi_C\rangle$ describe the center-of-mass motion for the reflected and transmitted beams (see Figure 37.5), respectively. The second microwave pulse action on both beams (the transmitted and the reflected), converts the internal state of the transmitted beam to state $|3\rangle$, while the reflected beam is converted to state $-|2\rangle$. Thus, the state vector after the pulse sequence shown in Figure 37.7 becomes:

$$|\psi\rangle \propto -|\psi_B\rangle \otimes |2\rangle + |\psi_C\rangle \otimes |3\rangle \qquad (37.8)$$

Eq. (37.8) shows that the internal state is correlated with the way taken by the atom. The which-way information can be read out later by performing a measurement of the internal atomic state. The result of this measurement reveals which way the atom took: if the internal state is found to be $|2\rangle$, the atom moved along beam B, otherwise it moved along beam C.

After considering a single beam splitter, now consider the complete interferometer. Sandwiching the first Bragg beam splitter between two $\pi / 2$ microwave pulses produces a reflected and transmitted beam each of a single internal atomic state, as described above. We note that the second Bragg beam splitter does not change the internal state. **No fringes are experimentally observed in this case.** The data is recorded with the same parameters with the only difference being that two microwave pulses are added to produce a single internal atomic state according to the particular path of the atom. Atoms in both hyperfine states are detected. The interference pattern is also not observed when only atoms in state $|2\rangle$ or only atoms in state $|3\rangle$ are detected. Of course, the absolute size of the signal is reduced by a factor of two in these cases. The key to this new experiment is that although the interferences are destroyed, the initially imposed atomic momentum distribution leaves an envelope pattern (in which the fringes used to reside) at the detector. **A careful analysis of the pattern finds that it has not been measurably distorted by a momentum kick of the type**

invoked by Bohr, and therefore that any locally realistic momentum kicks imparted by the manipulation of the internal atomic state according to the particular path of the atom are too small to be responsible for destroying interference.

In order to investigate why the interference is lost, we consider the state vector for the interaction sequence used which causes the disappearance of the fringes. The state vector after the interaction with the first beam splitter sandwiched between the two microwave pulses is given by Eq. (37.8). The second beam splitter transforms this state vector into a left peak and a right peak given by:

$$\left|\psi_{left}\right\rangle \propto -\left|\psi_D\right\rangle \otimes\left|2\right\rangle + \left|\psi_E\right\rangle \otimes\left|3\right\rangle \tag{37.9}$$

and

$$\left|\psi_{right}\right\rangle \propto \left|\psi_F\right\rangle \otimes\left|2\right\rangle + \left|\psi_G\right\rangle \otimes\left|3\right\rangle \tag{37.10}$$

where the sign of $\left|\psi_F\right\rangle$ is positive due to the π phase shift during the reflection from the second beam splitter. Each peak is a superposition of atoms which follow separate paths and comprise atoms of a single internal state. In each case atoms which interfere have internal states which are orthogonal; thus, in the far field, the atomic position distribution under the each peak of the envelope is given by the superposition of two single slit patterns rather than the double slit pattern in the absence of the application of the $\pi / 2$ microwave pulses. In the far field, the amplitude of the atomic position distribution under each peak of the envelope $\tilde{\Psi}(x)$ is the sum of the independent Fraunhofer planes and the intensity of the atomic position distribution under each peak of the envelope $\tilde{\Psi}^2(x)$ is given by

$$\tilde{\Psi}^2(x) = (2aC)^2 \ \text{sinc}^2\left(\frac{kax}{f}\right) \tag{37.11}$$

where f is the focal length and a is the slit width. In the present case, the envelope of the fringe pattern is given by the collimation properties of the initial atomic beam A.

A dramatic change in the spatial momentum distribution occurs when adding the microwave fields to the interferometer that manifests itself as loss of interference; even though, the microwave itself does not transfer enough momentum to the atom to wash out the fringes according to the Heisenberg Uncertainty Principle. The addition of the microwave fields modifies the probability for momentum transfer by the light fields. This modification of the momentum transfer probability is due to the manipulation of the internal atomic state according to the particular path of the atom. The disappearance of interference is explained by classical quantum mechanics.

15. Applicant's response to the Secret Committee's "Response to the argument that Feynman's derivation of the Bohr radius is flawed"

In the first Office Action, the Secret Committee presented the Feynman derivation as the proof that quantum mechanics predicts the ground state of the hydrogen atom, the experimental parameters of which are known to at least 6 significant figures. In the Final Office Action on page 31, the Committee has reduced the status of its argument to the following:

> "Initially, it is noted that the purpose of Feynman's derivation was to demonstrate *a back-of-the-envelop estimate* that would give some idea of the size of the hydrogen atom in its ground state in light of the Heisenberg Uncertainty Principle."

Since this was the only "physical" argument made by the Secret Committee that quantum mechanics predicts the ground state of hydrogen, we must conclude that the Committee can not support its position that a ground state exists in quantum theory by any other mechanism than by a definition based on the current data. The recent data of Applicant summarized in Section I of this Response requires revisions to or, better yet, abandonment of Quantum Theory, whether the Committee likes it or not. Only Applicant's theory is in compliance with the real world, lower-energy hydrogen, not Quantum Theory.

16. Applicant's response to the Secret Committee's contention that "Applicant's description of the prior art is incorrect"

Applicant submits that the "Prior Art" referred to by the Secret Committee should relate to compositions of matter — not equations. By the PTO's own admission, lower-energy hydrogen cannot exist, and therefore, by definition, there can be no prior art! Indeed, there are no prior art rejections of record.

Nevertheless, Applicant did not fail to compare his work with the closest theoretical work. The corresponding derivations based on Maxwell's equations with closed form solutions

containing fundamental constants only are given by Applicant. The predictions match the experimental data remarkably well.[164]

As reported in Table 9-1 of McQuarrie, Kolos and Wolniewcz use 100 "terms" and an effective nuclear charge of 1.072.[165]

The effective nuclear charge is a fudge factor that provides agreement with the experimental result. The charge of the nucleus is $+1.6021892 \, X10^{-19} \, C$—not 1.072 times this value. The value used by Applicant was the fundamental constant $e = +1.6021892 \, X 10^{-19} \, C$. Other corresponding flaws in quantum mechanics associated with the paper of Kolos and L. Wolniewicz are given in the Schrodinger Equation Fails to Explain Scattering Experiments section of Applicant .[166]

Regarding Kolos and Roothaan, the Secret Committee is again referred to Table 9-1 of McQuarrie.[167] McQuarrie presents 13 different methods for the calculation of the parameters of the hydrogen molecule. The number of terms span two to 100 with totally inconsistent and contradictory approaches which are NOT RIGOROUS—valance bond, molecular orbital with sigma bonds, pi bonds, delta bond, banana bonds, bonding orbitals, antibonding orbitals, *(negative probability density as well as positive probability density)*, back-bonding orbitals (empty space), coulomb integrals, Hartree-Fock, self consistent field method, Slater orbitals, ionic terms, mixing of wavefunctions with adjustable parameters, valence-shell electron-pair-repulsion (VSEPR) method, etc., etc.—wherein all of these approaches totally disregard conservation of energy, momentum, and radiation according to Maxwell's equations. The results range from 2.7 eV for the bond energy of the hydrogen molecule to 4.7467 eV given by Kolos

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[164] Reference 39 at Chapter 12.

[165] Reference 65 at page353 and Reference 75 at page 404.

[166] Reference 32.

[167] Reference 65 at page 353.

and L. Wolniewicz rather than Kolos and Roothaan as cited by the Secret Committee. The entry corresponding to an effective nuclear charge of 1.197 was actually due to C. A. Coulson, Trans. Far. Soc., Vol. 33, (1937), p. 1479. (*Kolos and Roothaan give 3.634 eV for the bond energy of the hydrogen molecule which differs from the experimental value by 22%.*) The bond energy given for the case of Coulson in Table 9-1 is 3.48 eV which differs from the experimental by 29%. Applicant apologizes for citing the wrong author for this result, but the identity of the author is irrelevant to Applicant's point.

The Secret Committee further states on page 36 of the Office Action that:

> In fact Kolos and Roothaan computed a binding energy of 4.7466 and 4.74367 eV (i.e. in electron volts) compared to the experimental value of $4.7466 \pm 0.007\ eV$. See p. 225, right-hand column in the reference. The match between theory and experiment for the binding energy (applicant's "bond") energy is *nearly perfect* thus rendering applicant's statement of a 30% discrepancy in that energy value to be an unsupported allegation.

> It is concluded that, contrary to Applicant's imputation, quantum mechanics cannot be flawed if, especially, in the very examples cited by Applicant himself, there is an accuracy match between quantum theory and experiment. *It is apparent that applicant has confused the advances that are made in a sound scientific theory, such as quantum mechanics as being indicative of so-called flaws. Moreover, under careful scrutiny, these "flaws" appear to be <u>unsupported</u> allegations.*

Actually, as reported in Table 9-1 of McQuarrie, *Kolos and Roothaan give 3.634 eV for the bond energy of the hydrogen molecule which differs from the experimental value by 22%.*[168]

Kolos and L. Wolniewicz *"computed a binding energy of 4.7466 and 4.74367 eV (i.e. in electron volts) compared to the experimental value of* $4.7466 \pm 0.007\ eV$ *"* by using *100 terms and an effective nuclear charge of 1.072.* This is classic of quantum mechanics—the manipulation of terms—ionic character, valance character, polarization, effective nuclear charge,

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[168] Reference 65 at page 353.

shielding terms—use what ever *fudge factors* that are required to arrive at a desired theoretical value which the authors faithfully did. The only **problem** is that the experimental bond energy of H_2 is **not** $4.7466 \pm 0.007 \, eV$. The experimental bond energy of the hydrogen molecule is $E_D = 4.478 \, eV$.[169] The result is only *nearly perfect* of a number which is **NOT THE EXPERIMENTAL BOND ENERGY**. A theoretical and experimental discussion of zero order vibration, like zero point energy, regarding violation of the Second Law of Thermodynamics and violation of Maxwell's equations which further disproves the Heisenberg Uncertainty Principle appears in R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, Chp. 14. If the Secret Committee chooses the cited model or any from the 13 given in Table 9-1 as the quantum mechanical result, then the model is in error.

Applicant's theory gives the bond energy as a closed form equation based on Maxwell's equations without a plethora of fudge factors. MAXWELLIAN SOLUTIONS ARE UNIQUE— Not an infinite number of arbitrary inconsistent algorithms as is the case with quantum mechanics. From R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, Chapter 12, pp. 321-322:

ENERGIES OF THE HYDROGEN MOLECULE

The energies of the hydrogen molecule are given by Eqs. (12.131-12.138) where $p = 1$

$$V_e = \frac{-2e^2}{8\pi\varepsilon_o\sqrt{a^2 - b^2}} \ln\frac{a + \sqrt{a^2 - b^2}}{a - \sqrt{a^2 - b^2}} = -67.813 \, eV \tag{12.191}$$

$$V_p = \frac{e^2}{8\pi\varepsilon_o\sqrt{a^2 - b^2}} = 19.23 \, eV \tag{12.192}$$

$$T = \frac{\hbar^2}{2m_e a\sqrt{a^2 - b^2}} \ln\frac{a + \sqrt{a^2 - b^2}}{a - \sqrt{a^2 - b^2}} = 33.906 \, eV \tag{12.193}$$

The energy, V_m, of the magnetic force is

$$V_m = \frac{-\hbar^2}{4m_e a\sqrt{a^2 - b^2}} \ln\frac{a + \sqrt{a^2 - b^2}}{a - \sqrt{a^2 - b^2}} = -16.9533 \, eV \tag{12.194}$$

$$E_T = V_e + T + V_m + V_p \tag{12.195}$$

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[169] Reference at page 589.

$$E_T = -13.6\,eV\left[\left(2\sqrt{2} - \sqrt{2} + \frac{\sqrt{2}}{2}\right)\ln\frac{\sqrt{2}+1}{\sqrt{2}-1} - \sqrt{2}\right] = -31.63\,eV \tag{12.196}$$

$$E(2H[a_H]) = -27.21\,eV \tag{12.197}$$

The bond dissociation energy, E_D, is the difference between the total energy of the corresponding hydrogen atoms and E_T.

$$E_D = E(2H[a_H]) - E_T = -27.2 + 31.63\,eV = 4.43\,eV \tag{12.198}$$

...

The vibrational energy E_{vib} of the hydrogen molecule given by Eq. (12.161) is

$$E_{vib} = 0.543\,eV \tag{12.202}$$

The experimental vibrational energy of the hydrogen molecule [6] is

$$E_{vib} = 0.545\,eV \tag{12.203}$$

Remarkably, as shown in Table 9-1, neither Kolos and Wolniewicz or Kolos and Roothaan even reported a vibrational energy which is experimentally $E_{vib} = 0.545\,eV$ (over 10% of the bond energy). This makes any reported 5 significant figure bond energy very dubious. The Secret Committee touts on page 35 of the Office Action that:

> This is a remarkable level of accuracy considering the formidable integrals for *interelectronic interactions* i.e. integral over $1/|r_1 - r_2|$, that had to be numerically evaluated in the course of the calculation as well the use of such approximations as the adiabatic approximation, due to Born, in which nuclear and electronic motion are separated in order to facilitate calculations.

The calculations of Kolos and L. Wolniewicz are extraordinarily dubious since the "formidable integrals for *interelectronic interactions* i.e. integral over $1/|r_1 - r_2|$" touted by the Secret Committee blow up to infinity, and any procedure to remove the infinities is purely arbitrary and not based on first principle physics.

These problems do not exist in Applicant's closed form derivation from first principles. In addition, the quantum mechanical model must be further revised based on the experimental observation of the following data predicted by Applicant's solution of the hydrogen molecular ion given in Section I of this Response:

7.) the observation of novel EUV emission lines from microwave discharges of argon or helium with 10% hydrogen that matched those predicted for vibrational transitions of $H_2^*[n = 1/4; n^* = 2]^+$ with energies of $\upsilon \cdot 1.185 \ eV$, $\upsilon = 17 \ to \ 38$ that terminated at the predicted dissociation limit, E_D, of $H_2[n = 1/4]^+$, $E_D = 42.88 \ eV \ (28.92 \ nm)$,[170]

17. Applicant's response to the Secret Committee's "Response to the argument that the Schrodinger equation fails and that the Dirac's electrodynamics is fatally flawed"

The QED method of the determination of $(g - 2)/2$ from the *postulated* Dirac equation is based on a *postulated* powers series of α / π where each *postulated* virtual particle is a source of *postulated* vacuum polarization that gives rise to a *postulated* term which is processed over decades using ad hoc rules to remove infinities from each term that arises from *postulated* scores of *postulated* Feynman diagrams. But rather than based on postulated polarization of the vacuum due to postulated virtual particles with corresponding QED terms which are renormalized according to postulated algorithms. A similar approach is used to calculate the Lamb shift. The methods used are not based on physics as represented by the veneer of the equation presented by the Secret Committee. The members of the Committee fail to be forth coming with the severe problems of these theories.[171]

As discussed throughout this Response [See Sections I, 2-4, 6, 14, and 17], the Schrodinger equation, Dirac equation, and QED are not based on physical laws. It is a gross misrepresentation to promulgate the position that these theories are a series of further refinements based on applying a physics algorithm which includes more precise terms. In fact, these theories are internally inconsistent, nonrigorous, and have individual inescapable physical consequences. The Schrodinger equation has 18 experimental and mathematical flaws, for example, it missed

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[170] Reference 20.

[171] Reference 39 at Appendix II: Quantum Electrodynamics (QED) is Purely Mathematical and Has No Basis in Reality.

spin. The Dirac equation missed the Lamb shift and fails at the Klein Paradox. The Dirac equation and QED have inescapable physical consequences such as the prediction of an infinite cosmological constant and a perpetual motion machine of the first kind. Another consequence of the Heisenberg Uncertainty Principle wherein entanglement of states is implicit is the prediction of a perpetual motion machine of the second kind.[172]

It is debasing to the PTO to reject Applicant's application based on a theory which has as an inescapable consequence proven by S. Hawking of the prediction of <u>perpetual motion</u>.[173] Hawking shows that in addition to the Heisenberg Uncertainty Principle quantum mechanics demands an IGNORANCE PRINCIPLE.

By the PTO's own admission, a theory or technology that predicts, as a consequence, perpetual motion – which the Secret Committee falsely associated with Applicant's theory and technology – **must be rejected as inoperable**. Thus, the PTO's reliance on Quantum Theory principles, which predict perpetual motion, is misplaced. Applicant notes, thankfully, that the Secret Committee has since dropped its outrageous claim that the subject mater of the present application is associated with perpetual motion.

Experimental data show that the consequences of both principles intrinsic to quantum mechanics are fatally flawed.[174] Applicant's theory based on first principles does not encounter these problems.

As discussed in Section I of this Response. Quantum Theory gives correlations with experimental data. It does not explain the mechanism for the observed data. But, it should not

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[172] Reference 39 at Forward, Introduction, Chapter 1, Appendix II: Quantum Electrodynamics (QED) is Purely Mathematical and Has No Basis in Reality, Appendix III: Muon g Factor, and Chapter 37; and Reference 32.

[173] Reference 39 at Appendix II: Quantum Electrodynamics (QED) is Purely Mathematical and Has No Basis in Reality.

[174] Reference 32 and 39 at Appendix II: Quantum Electrodynamics (QED) is Purely Mathematical and Has No Basis in Reality.

be surprising that it gives good correlations given that the constraints of internal consistency and conformance to physical laws are removed for a wave equation with an infinite number of solutions wherein the solutions may be formulated as an infinite series of eigenfunctions with variable parameters. There are no physical constraints on the parameters. They may even correspond to unobservables or "flights of fantasy" such as probability waves, virtual particles, negative energy of the vacuum, polarization of the vacuum by virtual particles, infinities, renormalization, effective nuclear charge, ionic terms in the perturbation series, fermion propagators, virtual photon annihilation, virtual photon emission and reabsorption, virtual electron positron annihilation, photon propagators, plethora of postulated super-symmetry virtual particles which make contributions such as smuon-neutralino and sneutrino-chargino loops, neutrino oscillation, worm holes, parallel universes, hyperdimensions, parallel mind universes, quantum telepathy, entanglement, spooky actions at a distance, faster than light travel, dark energy, exotic particles comprising dark matter, the universe from nothing, big bang-inflation-deceleration-reacceleration of the universe, and so on and so on. With mathematics, it is possible to represent an infinite number of models with limitless fantasy. If you invoke the constraints of internal consistency and conformance to physical laws, quantum mechanics has never successfully solved a physical problem.

Throughout the history of quantum theory, wherever there was an advance to a new application, it was necessary to repeat a trial and error experimentation to find which method of calculation gave the right answers. Often the textbooks present only the successful procedure as if it followed from first principles; and do not mention the actual method by which it was found. In electromagnetic theory based on Maxwell's equations, one deduces the computational algorithm from the general principles. In quantum theory, the logic is just the opposite. One chooses the principle to fit the empirically successful algorithm. For example, we know that it required a great deal of art and tact over decades of effort to get correct predictions out of Quantum Electrodynamics (QED). For the right experimental numbers to emerge, one must do the calculation (i.e. subtract off the infinities) in one particular way and not in some other way that appears in principle equally valid. There is a corollary, noted by Kallen: from an

inconsistent theory, any result may be derived.

The predictions of Applicant's Classical Quantum Mechanics (CQM) are unprecedented in that agreement with observations which is achieved over 85 orders of magnitude from the scale of fundamental particles to that of the cosmos. Observable features of atomic particles such as the electron g factor may be calculated in closed form from Maxwell's equations with 11-figure accuracy without invoking the vagaries and inconsistencies inherent with quantum mechanics and the Heisenberg Uncertainty Principle.

The Lamb Shift of the $2P_{1/2}$ state of the hydrogen atom having the quantum number $\ell = 1$ is calculated by Applicant by applying conservation of energy and linear momentum to the emitted photon, electron, and atom.[175] A summary from R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, in press, follows:

LAMB SHIFT

The Lamb Shift of the $2P_{1/2}$ state of the hydrogen atom is due to conservation of linear momentum of the electron, atom, and photon. The electron component is

$$\Delta f = \frac{\Delta \omega}{2\pi} = \frac{E_{h\nu}}{h} = 3\frac{\left(E_{h\nu}\right)^2}{h\,2m_e c^2} = 1052 \; MHz \tag{65}$$

where $E_{h\nu}$ is

$$E_{h\nu} = 13.6\left(1 - \frac{1}{n^2}\right)\frac{1}{\left|X_{lm}\right|^2_{\ell=1}} - h\Delta f \tag{66}$$

$$E_{h\nu} = 13.6\left(1 - \frac{1}{n^2}\right)\frac{3}{8\pi} - h\Delta f \tag{67}$$

$$h\Delta f <<< 1 \tag{68}$$

Therefore,

$$E_{h\nu} = 13.6\left(1 - \frac{1}{n^2}\right)\frac{3}{8\pi} \tag{69}$$

the atom component is

$$\Delta f = \frac{\Delta \omega}{2\pi} = \frac{E_{h\nu}}{h} = \frac{1}{2}\frac{\left(E_{h\nu}\right)^2}{2m_H c^2} = 6.5 \; MHz \tag{70}$$

The sum of the components is

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[175]Reference 39 at Chapter 2.

$$\Delta f = 1052\ MHz + 6.5\ MHz = 1058.5\ MHz \tag{71}$$

The experimental Lamb Shift is $1058\ MHz$.

Applicant calculates the electron g factor from first principles: conservation of angular momentum and the Poynting Power vector.

ELECTRON g FACTOR

Conservation of angular momentum of the orbitsphere permits a discrete change of its "kinetic angular momentum" $(\mathbf{r} \times m\mathbf{v})$ by the applied magnetic field of $\dfrac{\hbar}{2}$, and concomitantly the "potential angular momentum" $(\mathbf{r} \times e\mathbf{A})$ must change by $-\dfrac{\hbar}{2}$.

$$\Delta \mathbf{L} = \frac{\hbar}{2} - \mathbf{r} \times e\mathbf{A} \tag{18}$$

$$= \left[\frac{\hbar}{2} - \frac{e\phi}{2\pi}\right]\hat{z} \tag{19}$$

In order that the change of angular momentum, $\Delta \mathbf{L}$, equals zero, ϕ must be $\Phi_0 = \dfrac{h}{2e}$, the magnetic flux quantum. The magnetic moment of the electron is parallel or antiparallel to the applied field only. During the spin-flip transition, power must be conserved. Power flow is governed by the Poynting power theorem,

$$\nabla \bullet (\mathbf{E} \times \mathbf{H}) = -\frac{\partial}{\partial t}\left[\frac{1}{2}\mu_o \mathbf{H} \bullet \mathbf{H}\right] - \frac{\partial}{\partial t}\left[\frac{1}{2}\varepsilon_o \mathbf{E} \bullet \mathbf{E}\right] - \mathbf{J} \bullet \mathbf{E} \tag{20}$$

Eq. (21) gives the total energy of the flip transition which is the sum of the energy of reorientation of the magnetic moment (1st term), the magnetic energy (2nd term), the electric energy (3rd term), and the dissipated energy of a fluxon treading the orbitsphere (4th term), respectively,

$$\Delta E_{mag}^{spin} = 2\left(1 + \frac{\alpha}{2\pi} + \frac{2}{3}\alpha^2\left(\frac{\alpha}{2\pi}\right) - \frac{4}{3}\left(\frac{\alpha}{2\pi}\right)^2\right)\mu_B B \tag{21}$$

$$\Delta E_{mag}^{spin} = g\mu_B B \tag{22}$$

where the stored magnetic energy corresponding to the $\dfrac{\partial}{\partial t}\left[\dfrac{1}{2}\mu_o \mathbf{H} \bullet \mathbf{H}\right]$ term increases, the stored electric energy corresponding to the $\dfrac{\partial}{\partial t}\left[\dfrac{1}{2}\varepsilon_o \mathbf{E} \bullet \mathbf{E}\right]$ term increases, and the $\mathbf{J} \bullet \mathbf{E}$ term is dissipative. The spin-flip transition can be considered as involving a magnetic moment of g times that of a Bohr magneton. The g factor is redesignated the fluxon g factor as opposed to the anomalous g factor. The calculated value of $\dfrac{g}{2}$ is 1.001 159 652 137. The experimental

value [4] of $\frac{g}{2}$ is 1.001 159 652 188(4).

These results more than meet the criterion of the Secret Committee: ACCURACY OF THE PREDICTIONS MEANS THE THEORY IS CORRECT. The Secret Committee's rule makes more sense in the case of Applicant's theory given the significant feature that Applicant's theory is actually based on physics rather that probability waves and unobservables such as virtual particles.

On page 43 of the Office Action, the Secret Committee states: "Applicant's reference to the 'kinetic energy of rotation' is a distortion of basic scientific terminology." The Secret Committee is misguided in its implication that Applicant means anything other than the energy associated with the motion of the electron about the nucleus by the term "kinetic energy of rotation." At page 365, Margenau and Murphy[176] state:

> ... but with the term $\dfrac{\ell(\ell+1)\hbar^2}{2mr^2}$ added to the normal potential energy. What is the meaning of that term? In classical mechanics, the energy of a particle moving in three dimensions differs from that of a one-dimensional particle by the kinetic energy of rotation, $\dfrac{1}{2}mr^2\omega^2$. This is precisely the quantity $\dfrac{\ell(\ell+1)\hbar^2}{2mr^2}$, for we have seen that $\ell(\ell+1)\hbar^2$ is the *certain* value of the square of the angular momentum for the state Y_ℓ, in classical language $\left(mr^2\omega^2\right)^2$ which is divided by $2mr^2$, gives exactly the kinetic energy of rotation.

The Secret Committee admits on page 43 of the Office Action that:

> ... the angular momentum quantum number, ℓ, is naturally zero for the ground state of the electron.

Thus, the Schrodinger equation is fatally flawed.[177]

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[176] Reference 57 at page 365.

[177] Reference 32.

In the time independent Schrodinger equation, the kinetic energy of rotation K_{rot} is given by

$$K_{rot} = \frac{\ell(\ell+1)\hbar^2}{2mr^2} \tag{10}$$

where

$$L = \sqrt{\ell(\ell+1)\hbar^2} \tag{11}$$

is the value of the electron angular momentum L for the state $Y_{lm}(\theta,\phi)$.

The POSTULATED Schrodinger Equation Fails to Solve the Hydrogen Atom Correctly

The paper by Applicant rigorously analyzes the Schrodinger equation.[178] One of many possible solutions of the postulated Schrodinger equation gives the Rydberg levels as does the theory of Bohr. On this basis alone, it is justified despite its inconsistency with physicals laws and numerous experimental observations such as:

• The appropriate eigenvalue must be postulated and the variables of the Laguerre differential equation must be defined as integers in order to obtain the Rydberg formula.

• The Schrodinger equation is not Lorentzian invariant.

• The Schrodinger equation violates first principles including special relativity and Maxwell's equations.

• The Schrodinger equation gives no basis why excited states are radiative and the 13.6 eV state is stable. Mathematics does not determine physics. It only models physics.

• In the time independent Schrodinger equation, the kinetic energy of rotation K_{rot} is given by Eq. (10) where the value of the electron angular momentum L for the state $Y_{lm}(\theta,\phi)$ is given by Eq. (11). The Schrodinger equation solutions, Eq. (10) and Eq. (11), predict that the

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[178] References 32 and 45.

ground state electron has zero angular energy and zero angular momentum, respectively.

• The Schrodinger equation solution, Eq. (11), predicts that the ionized electron may have infinite angular momentum.

• The Schrodinger equation solutions, Eq. (10) and Eq. (11), predict that the excited state rotational energy levels are nondegenerate as a function of the ℓ quantum number even in the absence of an applied magnetic field, and the predicted energy is over six orders of magnitude of the observed nondegenerate energy in the presence of a magnetic field. In the absence of a magnetic field, no preferred direction exists. In this case, the ℓ quantum number is a function of the orientation of the atom with respect to an arbitrary coordinate system. Therefore, the nondegeneracy is nonsensical and violates conservation of angular momentum of the photon.

• The Schrodinger equation predicts that each of the functions that corresponds to a highly excited state electron is not integrable and can not be normalized; thus, each is infinite.

• The Schrodinger equation predicts that the ionized electron is sinusoidal over all space and can not be normalized; thus, it is infinite.

• The Heisenberg uncertainty principle arises as the standard deviation in the electron probability wave, but experimentally it is not the basis of wave particle duality as shown in the Appendix.

• Quantum mechanical textbooks express the movement of the electron, and the Heisenberg uncertainty principle is an expression of the statistical aspects of this movement. McQuarrie [15], gives the electron speed in the $n = 1$ state of hydrogen as $2.18764 \, X \, 10^6 \, m/\sec$. Remarkably, the uncertainty in the electron speed according to the uncertainty principle is $1.4 \, X \, 10^7 \, m/\sec$ [16] which is an order of magnitude larger that the speed.

• Experimentally the electron has precise velocity, kinetic energy, and angular momentum. Acquiring these exact properties instantaneously defies all known physical principles.

• The correspondence principle does not hold experimentally.

• The Schrodinger equation does not predict the electron magnetic moment and misses the spin quantum number all together.

• The Schrodinger equation is not a wave equation since it gives the velocity squared proportional to the frequency.

• The Schrodinger equation is not consistent with conservation of energy in an inverse potential field wherein the binding energy is equal to the kinetic energy and the sum of the binding energy and the kinetic energy is equal to the potential energy.

• The Schrodinger equation permits the electron to exist in the nucleus which is a state that is physically nonsensical with infinite potential energy and infinite negative kinetic energy.

• The Schrodinger equation interpreted as a probability wave of a point particle can not explain neutral scattering of electrons from hydrogen.

• The Schrodinger equation interpreted as a probability wave of a point particle gives rise to infinite magnetic and electric energy in the corresponding fields of the electron.

• A modification of the Schrodinger equation was developed by Dirac to explain spin which relies on the unfounded notions of negative energy states of the vacuum, virtual particles, and gamma factors.

The electron must be moving about the nucleus; otherwise, it could not be bound[179] and this situation would be inconsistent with the Schrodinger equation which has a term for the corresponding energy. Furthermore, experimentally the angular momentum is $\hbar$ corresponding to the electron's motion about the nucleus. Thus, the Schrodinger equation predictions are not in agreement with experimentation and are not internally consistent. These problems do not exist in Applicant's theory.[180]

The Schrodinger equation solution wave functions for continuum states correspond to sinusoids over all space; thus, they are nonsensical and do not give the experimentally observed plane for the free electron which is pulled out of thin air by the Secret Committee. In addition, $\ell = n - 1$. The electron is ionized as $n \to \infty$ corresponding to $\ell \to \infty$. According to Eq. (10) and (11) of Reference 32, the rotational kinetic energy and angular momentum both become infinite versus the observed zero and $\hbar$, respectively.

If the Schrodinger equation is to be used to pass judgment on the existence of lower-energy states of hydrogen, than at a minimum it must be internally consistent and predict the known states. The results of the Schrodinger equation are nonsensical for excited states and the continuum states. The Schrodinger equation predicts that each of the functions that corresponds to a highly excited state electron is not integrable and can not be normalized; thus, each is infinite. The energy and angular momentum is also nonsensical. These problems do not exist in Applicant's theory.[181] The free electron is solved by Applicant from first principles. The

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[179] This condition is demanded by conservation of energy with an inverse square force [See Fowles, G. R., *Analytical Mechanics*, Third Edition, Holt, Rinehart, and Winston, New York, (1977), Chp. 5]. It is also demanded by the Schrodinger equation and the Heisenberg Uncertainty Principle.

$$\Delta x \Delta \mathbf{p} \geq \frac{\hbar}{2}$$

In the case that the momentum is zero, the particle is over all space an is unbound.

[180]Reference 39 at Chapters 1 and 2.

[181] Reference 39 at Chapters 1 and 2.

solution is in exact agreement with experimental observations.[182]

Given the definition of the rotational kinetic energy of Margenau and Murphy,[183] the Secret Committee has not addressed the following failure of the Schrodinger equation:

• The Schrodinger equation solutions, Eq. (10) and Eq. (11), predict that the excited state rotational energy levels are nondegenerate as a function of the ℓ quantum number even in the absence of an applied magnetic field, and the predicted energy is over six orders of magnitude of the observed nondegenerate energy in the presence of a magnetic field. In the absence of a magnetic field, no preferred direction exists. In this case, the ℓ quantum number is a function of the orientation of the atom with respect to an arbitrary coordinate system. Therefore, the nondegeneracy is nonsensical and violates conservation of angular momentum of the photon.

The relevance of Applicant's comments on the Heisenberg Uncertainty Principle and the Correspondence Principle to the applicability of the Schrodinger equation to the hydrogen atom is that inconsistencies and incongruities with observations arise which invalidates the Schrodinger equation as correctly representing the hydrogen atom. (The Secret Committee has used the argument that the Schrödinger equation is the absolute representation of the hydrogen atom; thus, it is the principle basis to reject the present patent application.)

According to quantum mechanics, the Schrodinger equation must obey the Heisenberg Uncertainty Principle. Quantum mechanical textbooks express the movement of the electron, and the Heisenberg Uncertainty Principle is an expression of the statistical aspects of this movement. McQuarrie [15], gives the electron speed in the $n = 1$ state of hydrogen as $2.18764 \, X \, 10^6 \, m/sec$. Remarkably, the uncertainty in the electron speed according to the uncertainty principle is $1.4 \, X \, 10^7 \, m/sec$ [16] which is an order of magnitude larger that the

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[182] Reference 39 at Chapter 3.

[183] Reference 57 at page 365.

speed. Experimentally the electron has precise velocity, kinetic energy, and angular momentum. Acquiring these exact properties instantaneously defies all known physical principles. The Heisenberg Uncertainty Principle is additionally experimentally disproved.[184] Thus, by their inseparable connection, the Schrodinger equation is not correct. Furthermore, the Correspondence Principle does not hold in the case of the Schrödinger equation. Thus, it violates conservation of angular momentum and is flawed.[185] This failure invalidates the Schrödinger equation as an absolute representation of the hydrogen atom.

The Schrödinger equation does violate conservation of energy in an inverse square field. The kinetic energy of rotation is always nondegenerate as discussed above.

Furthermore, the Secret Committee fails to acknowledge that quantum mechanics predicts that electron is in the nucleus despite supporting references. For the "ground state" electron of the hydrogen atom, Ψ^2 has a maximum at the nucleus. Since the nucleus has an experimentally measured nonzero volume, the integral of Ψ^2 over the volume of the nucleus is nonzero. Thus, according to quantum mechanics, the electron exists in the nucleus which leads to nonsensical results in terms on the potential and kinetic energy in an inverse central field. In addition, from R. Mills, The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory, Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096:

> According to quantum mechanics, the existence of the electron in the nucleus is the basis of spin-nuclear coupling called Fermi contact interaction[186] where $4\pi r^2 \Psi^2 dr$ is not zero since the Ψ^2 is not zero and the nucleus is comprised of baryons. According to the Standard Model, baryons as opposed to leptons have structure, contain more fundamental particles--namely quarks and gluons, and are not point particles. For example, the proton has an experimentally measured

[184] Reference 32.

[185] Reference 39 at Chapter 2.

[186] Reference 77 at page 567.

radius of $r_p = 1.3 \, X \, 10^{-15} \, m$. The spin-nuclear coupling energy is of the order of $10^{-24} \, J$ despite the infinite Coulombic energy of the electron when found in the nucleus (i.e. $r \rightarrow 0$ in the Schrodinger equation). This consequence of quantum mechanics is further flawed since this state is experimentally disproved. The nucleus does not contain electrons.[187] Since the electron has no volume, based on this logic, the probability that an electron can capture a photon to form an excited state is zero. This internal inconsistency based on the description of the electron as a point particle probability wave does not arise in Applicant's classical theory of quantum mechanics. The spin nuclear energies are calculated by Applicant in closed form based on first principles without the requirement that the electron is in the nucleus[188] and are in close agreement with the experimental results.

Furthermore, from R. Mills, The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory, Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096:

From Weisskopf [23], "Dirac's quantum electrodynamics gave a more consistent derivation of the results of the correspondence principle, but it also brought about a number of new and serious difficulties." Quantum electrodynamics; 1.) DOES NOT EXPLAIN NONRADIATION OF BOUND ELECTRONS; 2.) contains an internal inconsistency with special relativity regarding the classical electron radius - the electron mass corresponding to its electric energy is infinite (The Schrodinger equation fails to predict the classical electron radius); 3.) it admits solutions of negative rest mass and negative kinetic energy; 4.) the interaction of the electron with the predicted zero-point field fluctuations leads to infinite kinetic energy and infinite electron mass; 5.) Dirac used the unacceptable states of negative mass for the description of the vacuum; yet, infinities still arise. Dirac's equation which was postulated to explain spin relies on the unfounded notions of negative energy states of the vacuum, virtual particles, and gamma factors. All of these features are untenable or are inconsistent with observation. These problems regarding spin and orbital angular momentum and energies and the classical electron radius are nonexistence with CQM solutions [2].

It is further easy to see that an inverse-squared-field-energy conservation violation exists as shown by Applicant, since the Schrodinger equation has an improper form. From R. Mills,

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[187] Reference 78 at pate 407.

[188] Reference 79 at pages 98-109.

The Grand Unified Theory of Classical Quantum Mechanics, September 2001 Edition, Chapter 1, pp. 14-19:

In 1923, de Broglie suggested that the motion of an electron has a wave aspect— $\lambda = \dfrac{h}{p}$. This was confirmed by Davisson and Germer in 1927 by observing diffraction effects when electrons were reflected from metals. Schrödinger reasoned that if electrons have wave properties, there must be a wave equation that governs their motion. And, in 1926, he proposed the Schrödinger equation

$$H\Psi = E\Psi \tag{I.29}$$

where Ψ is the wave function, H is the wave operator, and E is the energy of the wave. To give the sought three quantum numbers, the Schrodinger equation solutions are three dimensional in space and four dimensional in spacetime

$$\left[\nabla^2 - \frac{1}{v^2}\frac{\partial^2}{\partial t^2}\right]\Psi(r,\theta,\phi,t) = 0 \tag{I.30}$$

where $\Psi(r,\theta,\phi,t)$ according to quantum theory is the probability density function of the electron as described below. When the time harmonic function is eliminated [12], the result is

$$-\frac{\hbar^2}{2\mu}\left[\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial\Psi}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial\Psi}{\partial\theta}\right)_{r,\phi} + \frac{1}{r^2\sin^2\theta}\left(\frac{\partial^2\Psi}{\partial\phi^2}\right)_{r,\theta}\right] + U(r)\Psi(r,\theta,\phi) = E\Psi(r,\theta,\phi) \tag{I.31}$$

where $U(r)$ is the classical Coulomb potential energy which in MKS units is

$$U(r) = -\frac{e^2}{4\pi\varepsilon_0 r} \tag{I.32}$$

The Schrodinger equation (Eq. (I.31)) can be transformed into a sum comprising a part that depends only on the radius and a part that is a function of angle only obtained by separation of variables and linear superposition in spherical coordinates. The general form of the solutions for $\psi(r,\theta,\phi)$ are

$$\psi(r,\theta,\phi) = \sum_{l,m} f_{lm}(r)Y_{lm}(\theta,\phi) \tag{I.33}$$

where l and m are separation constants. The solutions for the full angular part of Eq. (I.31), $Y_{lm}(\theta,\phi)$, are the spherical harmonics

$$Y_{lm}(\theta,\phi) = \sqrt{\frac{(2l+1)(l-m)!}{4\pi(l+m)!}}P_l^m(\cos\theta)e^{im\phi} \tag{I.34}$$

In general, the Schrödinger equation has an infinite number of solutions.
To arrive at the solution which represents the electron, a suitable boundary condition must be imposed. Schrödinger postulated a boundary condition: $\Psi \to 0$ as $r \to \infty$, which leads to a purely mathematical model of the electron. The historical solution [13] may be approached differently to arrive at a solution

which is based in physics. The angular part of Eq. (I.31) is the generalized Legendre equation which is derived from the Laplace equation by Jackson (Eq. (3.9) of Jackson [14]). For the case that the potential energy is a constant times the wavenumber of the electron, k (a constant times the inverse of the de Broglie wavelength of the electron—$k = \frac{2\pi}{\lambda}$; $\lambda = \frac{h}{p}$), the radial part of Eq. (I.31) is just

the Bessel equation, Eq. (3.75) of Jackson [14] with $\upsilon = l + \frac{1}{2}$. (In the present case of an inverse squared central field, the magnitude of each of the binding energy and the kinetic energy is one half the potential energy [11], and the de Broglie wavelength requires that the kinetic energy, $\frac{p^2}{2m_e}$, is a constant times the wavenumber squared.) Thus, the solution for $f_{lm}(r)$ is

$$f_{lm}(r) = \frac{A_{lm}}{r^{1/2}} J_{l+1/2}(kr) + \frac{B_{lm}}{r^{1/2}} N_{l+1/2}(kr) \tag{I.35}$$

It is customary to define the spherical Bessel, Neumann, and Hankel functions, denoted by $j_l(x)$, $n_l(x)$, $h_l^{(1,2)}(x)$, as follows:

$$j_l(x) = \left(\frac{\pi}{2x}\right)^{1/2} J_{l+1/2}(x)$$

$$n_l(x) = \left(\frac{\pi}{2x}\right)^{1/2} N_{l+1/2}(x) \tag{I.36}$$

$$h_l^{(1,2)}(x) = \left(\frac{\pi}{2x}\right)^{1/2} \left[J_{l+1/2}(x) \pm iN_{l+1/2}(x)\right]$$

For $l = 0$, the explicit forms are:

$$j_0(x) = \frac{\sin x}{x}$$

$$n_0(x) = -\frac{\cos x}{x} \tag{I.37}$$

$$h_0^{(1)}(x) = \frac{e^{ix}}{ix}$$

Eq. (I.31) has the general form

$$H\psi = E\psi \tag{I.38}$$

The energy is given by

$$\int_{-\infty}^{\infty} \psi H \psi dv = E \int_{-\infty}^{\infty} \psi^2 dv; \tag{I.39}$$

Typically, the solutions are normalized.

$$\int_{-\infty}^{\infty} \psi^2 dv = 1 \tag{I.40}$$

Thus,

$$\int_{-\infty}^{\infty} \psi H \psi dv = E \tag{I.41}$$

A physical interpretation of Eq. (I.38) is sought. Schrödinger interpreted $e\Psi * (x)\Psi(x)$ as the charge-density or the amount of charge between x and $x + dx$ ($\Psi *$ is the complex conjugate of Ψ). Presumably, then, he pictured the electron to be spread over large regions of space. Three years after Schrödinger's interpretation, Max Born, who was working with scattering theory, found that this interpretation led to logical difficulties, and he replaced the Schrödinger interpretation with the probability of finding the electron between x and $x + dx$ as

$$\int \Psi(x)\Psi * (x)dx \tag{I.42}$$

Born's interpretation is generally accepted. Nonetheless, interpretation of the wave function is a never-ending source of confusion and conflict. Many scientists have solved this problem by conveniently adopting the Schrödinger interpretation for some problems and the Born interpretation for others. This duality allows the electron to be everywhere at one time—yet have no volume. Alternatively, the electron can be viewed as a discrete particle that moves here and there (from $r = 0$ to $r = \infty$), and $\Psi\Psi *$ gives the time average of this motion. According to the Copenhagen interpretation, every observable exists in a state of superposition of possible states and observation or the potential for knowledge causes the wavefunction corresponding to the possibilities to collapse into a definite state. The postulate of quantum measurement asserts that the process of measuring an observable forces the state vector of the system into an eigenvector of that observable, and the value measured will be the eigenvalue of that eigenvector. Thus, Eq.(I.38) corresponds to collapsing the wave function, and E is the eigenvalue of the eigenvector.

However, an alternative interpretation of Eq. (I.38) and the corresponding solutions for ψ exist. In the case that ψ is a function given by Eqs. (I.35-I.37), Eq. (I.38) is equivalent to an inverse Fourier transform. The spacetime inverse Fourier transform in three dimensions in spherical coordinates is given [15-16] as follows:

$$M(s,\Theta,\Phi) = \int_0^\infty \int_0^\pi \int_0^{2\pi} \rho(r,\theta,\phi)\exp(-i2\pi sr[\cos\Theta\cos\theta + \sin\Theta\sin\theta\cos(\phi - \Phi)])r^2 \sin\theta dr d\theta d\phi$$

$$\tag{I.43}$$

With circular symmetry [15]

$$M(s,\Theta) = 2\pi \int_0^\infty \int_0^\pi \rho(r,\theta)J_o(2\pi sr\sin\Theta\sin\theta)\exp(-i2\pi sr\cos\Theta\cos\theta)r^2 \sin\theta dr d\theta \tag{I.44}$$

With spherical symmetry [15],

$$M(s) = 4\pi \int_0^\infty \rho(r)\operatorname{sinc}(2sr)r^2 dr = 4\pi \int_0^\infty \rho(r)\frac{\sin sr}{sr} r^2 dr \tag{I.45}$$

By substitution of the eigenvalues corresponding to the angular part [13], of Eq.

(I.33), the Schrödinger equation becomes the radial equation, $R(r)$, given by

$$-\frac{\hbar^2}{2\mu r^2}\frac{d}{dr}\left(r^2\frac{dR}{dr}\right)+\left[\frac{\hbar^2 l(l+1)}{2\mu r^2}+U(r)\right]R(r)=ER(r) \tag{I.46}$$

Consider the case that $l = 0$, that the potential energy is a constant times the wavenumber, and that the radial function is a spherical Bessel function as given by Eqs. (I.35-I.37). In this case, Eq. (I.46) is given by

$$4\pi\int_0^\infty\frac{\sin sr}{sr}\left[-\frac{\hbar^2}{2\mu r^2}\frac{d}{dr}\left(r^2\frac{d}{dr}\right)+U(r)\right]\frac{\sin sr}{sr}r^2 dr = E4\pi\int_0^\infty\frac{\sin sr}{sr}\frac{\sin sr}{sr}r^2 dr \tag{I.47}$$

Eq. (I.45) is the Fourier transform integral in spherical coordinates with spherical symmetry. The left hand side (LHS) of Eq. (I.47) is equivalent to the LHS of Eq. (I.41) wherein ψ is given by Eq. (I.37). Then the LHS of Eq. (I.47) is the Fourier transform integral of $H\psi$ wherein the kernel is $r^2\frac{\sin sr}{sr}$. The integral of Eq. (I.41) gives E which is a constant. The energy E of Eq. (I.38) is a constant such as b. Thus, $H\psi$ according to Eq. (I.38) is a constant times ψ.

$$H\psi = b\psi \tag{I.48}$$

where b is a constant. Since is b is an <u>arbitrary</u> constant, consider the following case wherein b is the Rydberg formula:

$$b = -\frac{Z^2 e^2}{8\pi\varepsilon_0 n^2 a_H} \tag{I.49}$$

Then the energy of Eq. (I.41) is that given by Eq. (I.1). But, the Schrödinger equation can be solved to give the energy corresponding to the radial function given by Eq. (I.4) of the Mills theory. The radial function used to calculate the energy is a delta function which corresponds to an inverse Fourier transform of the solution for ψ.

$$\Psi(s) = \delta(s - s_n) \tag{I.50}$$

With a change of variable, Eq. (I.50) becomes Eq.(I.4).

Eq. (I.47) can be expressed as follows

$$4\pi\int_0^\infty\frac{\sin sr}{sr}\left[-\frac{\hbar^2}{2\mu r^2}\frac{d}{dr}\left(r^2\frac{d}{dr}\right)+U(r)\right]\frac{\sin s_n r}{s_n r}r^2 dr = E4\pi\int_0^\infty\frac{\sin sr}{sr}\frac{\sin s_n r}{s_n r}r^2 dr \tag{I.51}$$

It follows from Eq. (I.45) that the right side integral is the Fourier transform of a radial Dirac delta function.

$$4\pi E\int_0^\infty\frac{\sin s_n r}{s_n r}\frac{\sin sr}{sr}r^2 dr = E\frac{\delta(s-s_n)}{4\pi s_n^2} \tag{I.52}$$

Substitution of Eq. (I.48) into Eq. (I.51) gives

$$4\pi b\int_0^\infty\frac{\sin s_n r}{s_n r}\frac{\sin sr}{sr}r^2 dr = b\frac{\delta(s-s_n)}{4\pi s_n^2} \tag{I.53}$$

Substitution of Eq. (I.52) and Eq. (I.53) into Eq. (I.51) gives

$$b\delta(s-s_n) = E\delta(s-s_n) \tag{I.54}$$

Consider the case where b is given by

$$b = -\frac{\hbar^2}{2m_e n \frac{a_0}{Z^2} s} = -\frac{\frac{1}{n}Z^2 e^2}{8\pi\varepsilon_0 s} \tag{I.55}$$

and s_n is given by

$$s_n = na_H \tag{I.56}$$

where $r_n = na_H$. According to the duality and change of scale properties of Fourier transforms [17], *the energy equation of the Mills theory and that of quantum mechanics are identical*, the energy of a radial Dirac delta function of radius equal to an integer multiple of the radius of the hydrogen atom[189]. The total energy of the electron is given by Poisson's Equation (Eq. (I.27)) and the relationship that the total energy is one half the potential energy in the case of an inverse squared central force [11].

$$E = \int_{-\infty}^{\infty} E\delta(r - r_n)dr = -\int_{-\infty}^{\infty} \delta(r - r_n)\frac{\frac{1}{n}Z^2 e^2}{8\pi\varepsilon_0 r}dr = -\frac{\frac{1}{n}Z^2 e^2}{8\pi\varepsilon_0 r_n} = -\frac{Z^2 e^2}{8\pi\varepsilon_0 n^2 a_H} \tag{I.57}$$

If the Schrodinger equation as an absolute is to be used to pass judgment on the existence of lower-energy states of hydrogen, then at a minimum, it must be internally consistent and be in agreement with experimental observation. In the case of electron scattering, the Schrödinger equation fails,[190] which invalidates it as the absolute representation of the hydrogen atom and makes mute the Secret Committee's argument that it can be used as the primary basis for the rejection of the present Patent Application.

Since in Applicant's theory, the electron is not a point, as incorrectly alleged by the Secret Committee, Applicant's current theory does not give rise to infinite energy in the corresponding

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[189] The mathematical relationship of Mills theory and quantum mechanics is based on the Fourier transform of the radial function. Mills theory requires that the electron is real and physically confined to a two dimensional surface which corresponds to a solution of the two-dimensional wave equation plus time. The corresponding Fourier transform is a wave over all space which is a solution of the three dimensional wave equation (e.g. the Schrödinger equation). In essence quantum mechanics may be considered as a theory dealing with the Fourier transform of an electron rather than the physical electron. By Parseval's theorem, the energies may be equivalent, but the quantum mechanical case is nonphysical—only mathematical. Thus, it is nonsensical from this perspective. It may mathematically produce numbers which agree with experimental energies, but the mechanisms lack internal consistency and conformity with physical laws. If these are the criterion for a valid solution of physical problems, then quantum mechanics has never successfully solved any problem. The theory of Bohr similarly failed.

[190] References 32 and 45.

electric and magnetic fields as is the case with quantum mechanics. Renormalization is purely arbitrary and has no basis in physics. It is merely a desperate mathematical attempt to salvage a theory which is not physically tenable.[191]

The Secret Committee states that a classical theory of Applicant can not predict the positron. The Secret Committee is in error. Quantum mechanic fails to predict particle masses as discussed by Applicant.[192] In contrast, Applicant's theory not only predicts the existence of the positron, it predicts its mass to high accuracy as well as those of the other fundamental particles:[193]

The Electron-Antielectron Lepton Pair

A clock is defined in terms of a self consistent system of units used to measure the particle mass.[194] The proper time of the particle is equated with the coordinate time according to the Schwarzschild metric corresponding to light speed. The special relativistic condition corresponding to the Planck energy gives the mass of the electron.

$$2\pi \frac{\hbar}{mc^2} = \sec\sqrt{\frac{2Gm^2}{c\alpha^2\hbar}} \tag{146}$$

$$m_e = \left(\frac{h\alpha}{\sec c^2}\right)^{\frac{1}{2}}\left(\frac{c\hbar}{2G}\right)^{\frac{1}{4}} = 9.1097 \, X \, 10^{-31} \, kg \tag{147}$$

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[191] Reference 32 and 39 at Forward and Appendix II: Quantum Electrodynamics (QED) is Purely Mathematical and Has No Basis in Reality.

[192] Reference 32.

[193] Reference 39 at Chapters 7, 28 and 30, and Reference 28.

[194] Presently the second is defined as the time required for 9,192,631,770 vibrations within the cesium-133 atom. The "sec" as defined in Eq. (146) is a fundamental constant, namely, the metric of spacetime (it is almost identically equal to the present value for reasons explained in ref. 1). A unified theory can only provide the relationships between all measurable observables in terms of a clock defined in terms of fundamental constants according to those observables and used to measure them. The so *defined "clock" measures "clicks" on an observable in one aspect, and in another, it is the ruler of spacetime of the universe with the implicit dependence of spacetime on matter-energy conversion* as shown in the Relationship of Matter to Energy and Spacetime Expansion section.

$$m_e = 9.1097 \: X \: 10^{-31} \: kg - 18 \: eV(v_e) = 9.1094 \: X \: 10^{-31} \: kg \tag{148}$$

$$m_{e \: experimental} = 9.1095 \: X \: 10^{-31} \: kg \tag{149}$$

Down-Down-Up Neutron (DDU)

The corresponding equation for production of the neutron is

$$2\pi \frac{2\pi\hbar}{\dfrac{m_N}{3}\left[\dfrac{1}{2\pi} - \dfrac{\alpha}{2\pi}\right]c^2} = \sec \sqrt{\frac{2G\left[\dfrac{m_N}{3}\left[\dfrac{1}{2\pi} - \dfrac{\alpha}{2\pi}\right]\right]^2}{3c(2\pi)^2\hbar}} \tag{150}$$

$$m_{N \: calculated} = (3)(2\pi)\left(\frac{1}{1-\alpha}\right)\left(\frac{2\pi\hbar}{\sec c^2}\right)^{\frac{1}{2}}\left(\frac{2\pi(3)ch}{2G}\right)^{\frac{1}{4}} = 1.6744 X 10^{-27} \: kg \tag{151}$$

$$m_{N experimental} = 1.6749 X 10^{-27} \: kg \tag{152}$$

Originally, the opposite sign of the square root result of the Dirac equation was ascribed to the proton.[195] It is a far stretch to attribute the positron to the Dirac equation, which gives no physical mechanism for the positron's creation or a means to predict its mass. The Dirac equation fails to predict any of the particles masses and it predicts infinities of virtual particles from the vacuum. From R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, Appendix II: Quantum Electrodynamics (QED) is Purely Mathematical and Has No Basis in Reality:

> The Rutherford experiment demonstrated that even atoms are comprised of essentially empty space [47]. Zero-point field fluctuations, virtual particles, and states of negative energy and mass invoked to describe the vacuum are nonsensical and have no basis in reality since they have never been observed experimentally and would correspond to an essentially infinite cosmological constant throughout the entire universe including regions of no mass. As given by Waldrop [48], "What makes this problem into something more than metaphysics is that the cosmological constant is observationally zero to a very high degree of accuracy. And yet, ordinary quantum field theory predicts that it ought to be enormous, about 120 orders of magnitude larger than the best observational limit. Moreover, this prediction is almost inescapable because it is a straightforward

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[195] Reference 78 at page 527.

application of the uncertainty principle, which in this case states that every quantum field contains a certain, irreducible amount of energy even in empty space. Electrons, photons, quarks—the quantum field of every particle contributes. And that energy is exactly equivalent to the kind of pressure described by the cosmological constant. The cosmological constant has accordingly been an embarrassment and a frustration to every physicist who has ever grappled with it."

Furthermore, a consequence of the Heisenberg Uncertainty principle and QED is that matter may be created from nothing, including vacuum. Taking quantum theory into account, Stephen Hawking [49-50] mathematically proved that blackholes must emit Hawking radiation comprising photons, neutrinos, and all sorts of massive particles. "The surface emits with equal probability all configurations of particles compatible with the observers limited knowledge. It is shown that the ignorance principle holds for quantum-mechanical evaporation of blackholes: The black hole creates particles in pairs, with one particle always falling into the hole and the other possibly escaping to infinity [50]." This QM theorem represents a perpetual motion machine with regard to spontaneous creation of mass and energy from the vacuum and with regard to gravitation. (QM also predicts a perpetual motion machine of the second kind [51-52]). Contrary to prediction, Hawking radiation has never been observed [53-55]. Classical laws including conservation of matter-energy are confirmed and QM is invalidated.

The fatally flawed inescapable predictions of the Dirac equation disproves it, which makes incredulous the claim that it predicted the positron.

It is further revealed that it is an incomplete theory since it gives no basis for gravity. In fact, the Dirac equation predicts an infinite cosmological constant.[196] Quantum mechanics also fails to predict lower-energy state hydrogen and as well as the mobility of free electrons in liquid helium which requires the existence of fraction quantum numbers.[197] Revisions to the current quantum mechanics are required. Applicant's theory match observation from the masses of particles to cosmological parameters.[198]

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[196] Reference 32.

[197] Reference 32.

[198] Reference 39.

Classical physics is remarkably successful at predicting the reality which we all experience and is indispensable as an engineering tool. In contrast, quantum mechanics has mathematics which may be adjusted to give numbers which may agree with measurements, but it is at the expense of abandoning reality. [See Section I of this Response] Applicant applies first principles congruent with reality over all scales starting with the application of Maxwell's equations to the observation that the hydrogen atom is stable to radiation in vacuum or isolation.[199] The results have been remarkable in terms of the diversity and accuracy of problems which can be solved and understood intuitively, such as the prediction of the mass of the top quark and the acceleration of the expansion of the universe before the observations were made.[200] Practical applications were sought. Classical Quantum Mechanics (CQM) makes predictions about novel reactions of atomic hydrogen. These prediction are confirmed experimentally in a broad range of internally consistent and reinforcing tests. The novel hydrogen chemistry of Applicant is no longer a theoretical argument but an experimental reality. [See Section I of this Response] The technological ramifications are extraordinary and vital.

Applicant further submits that the fine structure splitting hydrogen spectra can be derived from first principles without the failures that arise from the postulated Dirac equation approach, as follows. Reference is made to Applicant's latest book.[201] This closed-form solution, using fundamental constants only and no fudge factors or other corrections. The solution is unique. In contrast, in the conventional Dirac equation, there is an infinity of solutions, not a unique solution, many of which are unrealistic, such as vacuum polarization, negative kinetic energy states, and the like.

SPIN-ORBITAL COUPLING

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[199] Reference 39.

[200] Reference 39.

[201] Reference 39.

The electron's motion in the hydrogen atom is always perpendicular to its radius; consequently, as shown by Eq. (1.57), the electron's angular momentum of $\hbar$ is invariant. Furthermore, the electron is nonradiative due to its angular motion as shown in SPACETIME FOURIER TRANSFORM OF THE ELECTRON FUNCTION, Appendix I, and the Stability of Atoms and Hydrinos section.[202] The radiative instability of excited states is due to a radial dipole term in the function representative of the excited state due to the interaction of the photon and the excited state electron as shown in the Instability of Excited States section. The angular momentum of the photon given in the Equation of the Photon section is $\mathbf{m} = \dfrac{1}{8\pi} \operatorname{Re}[\mathbf{r} \times (\mathbf{E} \times \mathbf{B}^*)] = \hbar$. It is conserved for the solutions for the resonant photons and excited state electron functions given in the Excited States of the One-Electron Atom (Quantization) section and the Equation of the Photon section. Thus, the electrodynamic angular momentum and the inertial angular momentum are matched such that the correspondence principle holds. It follows from the principle of conservation of angular momentum that $\dfrac{e}{m_e}$ of Eq. (1.99) is invariant (See the Determination of Orbitsphere Radii r_n section).

A magnetic field is a relativistic effect of the electrical field as shown by Jackson [11]. No energy term is associated with the magnetic field of the electron of the hydrogen atom unless another source of magnetic field is present. In the case of spin-orbital coupling, the invariant $\hbar$ of spin angular momentum and orbital angular momentum each give rise to a corresponding invariant magnetic moment of a Bohr magneton, and their corresponding energies superimpose as given in the Orbital and Spin Splitting section. The interaction of the two magnetic moments gives rise to a relativistic spin-orbital coupling energy. The vector orientations of the momenta must be considered as well as the condition that flux must be linked by the electron in units of the magnetic flux quantum in order to conserve the invariant electron angular momentum of $\hbar$. The energy may be calculated with the additional conditions of the invariance of the electron's charge and mass to charge ratio $\dfrac{e}{m_e}$.

As shown in the Electron g Factor section (Eq. (1.149)), flux must be linked by the electron orbitsphere in units of the magnetic flux quantum that treads the orbitsphere at $v = c$ with a corresponding energy of

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[202] Reference 39.

$$E_{mag}^{fluxon} = 2\frac{\alpha}{2\pi}\mu_B B \tag{2.83}$$

As shown in the Orbitsphere Equation of Motion for $\ell = 0$ section, the maximum projection of the spin angular momentum of the electron onto an axis is $\sqrt{\frac{3}{4}}\hbar$. From Eq. (2.36), the magnetic flux due to the spin angular momentum of the electron is [5]

$$\mathbf{B} = \frac{\mu_0 \mu}{r^3} = \frac{\mu_0 e\hbar}{2m_e r_2^3}\sqrt{\frac{3}{4}} \tag{2.84}$$

The maximum projection of the orbital angular momentum onto an axis is $\hbar$ as shown in the Orbital and Spin Splitting section with a corresponding magnetic moment of a Bohr magneton μ_B. Substitution of the magnetic moment of μ_B corresponding to the orbital angular momentum and Eq. (2.84) for the magnetic flux corresponding to the spin angular momentum into Eq. (2.83) gives the spin-orbital coupling energy $E_{s/o}$.

$$E_{s/o} = 2\frac{\alpha}{2\pi}\mu_B B = 2\frac{\alpha}{2\pi}\left(\frac{e\hbar}{2m_e}\right)\frac{\mu_0 e\hbar}{2m_e r^3}\sqrt{\frac{3}{4}} \tag{2.85}$$

The Bohr magneton corresponding to the orbital angular momentum is invariant and the corresponding invariant electron charge e is common with that which gives rise to the magnetic field due to the spin angular momentum. The condition that the magnetic flux quantum treads the orbitsphere at $v = c$ with the maintenance of the invariance of the electron's mass to charge ratio $\frac{e}{m_e}$ and electron angular momentum of $\hbar$ requires that the radius and the electron mass of the magnetic field term of Eq. (2.85) be relativistically corrected. As shown in the SPACETIME FOURIER TRANSFORM OF THE ELECTRON FUNCTION and the Determination of Orbitsphere Radii r_n section, the relativistically corrected radius $r*$ follows from the relationship between the electron wavelength and the radius.

$$2\pi r = \lambda \tag{2.86}$$

As shown in the Excited States of the One-Electron Atom (Quantization) section, the phase matching condition requires that the electron wavelength be the same for orbital and spin angular momentum. With $v = c$,

$$r* = \lambda \tag{2.87}$$

Thus,

$$r^* = \frac{r}{2\pi} \qquad (2.88)$$

The relativistically corrected mass $m*$ follows from Eq. (2.88) with maintenance of the invariance of the electron angular momentum of $\hbar$ given by Eqs. (1.56) and (1.57).

$$m\mathbf{r} \times \mathbf{v} = m_e r \frac{\hbar}{m_e r} \qquad (2.89)$$

With Eq. (2.88), the relativistically corrected mass $m*$ is

$$m* = 2\pi m_e \qquad (2.90)$$

With the substitution of Eq. (2.88) and Eq. (2.89) into Eq. (2.85), the spin-orbital coupling energy $E_{s/o}$ is given by

$$E_{s/o} = 2\frac{\alpha}{2\pi}\left(\frac{e\hbar}{2m_e}\right)\frac{\mu_0 e\hbar}{2(2\pi m_e)\left(\frac{r}{2\pi}\right)^3}\sqrt{\frac{3}{4}} = \frac{\alpha\pi\mu_0 e^2\hbar^2}{m_e^2 r^3}\sqrt{\frac{3}{4}} \qquad (2.91)$$

(The magnetic field in this case is equivalent to that of a point electron at the origin with $\sqrt{\frac{3}{4}}\hbar$ of angular momentum.)

In the case that $n = 2$, the radius given by Eq. (2.2) is $r = 2a_0$. The predicted energy difference between the $2p_{3/2}$ and $2p_{1/2}$ levels of the hydrogen atom, $E_{s/o}$, given by Eq. (2.91) is

$$E_{s/o} = \frac{\alpha\pi\mu_0 e^2\hbar^2}{8m_e^2 a_0^3}\sqrt{\frac{3}{4}} = \frac{\alpha\pi\mu_0 e^2\hbar^2}{8m_e^2 a_0^3}\sqrt{\frac{3}{4}} \qquad (2.92)$$

wherein $\ell = 1$ and both levels are equivalently Lamb shifted.

$E_{s/o}$ may be expressed in terms of the mass energy of the electron. The energy stored in the magnetic field of the electron orbitsphere (Eq. (1.129)) is

$$E_{mag} = \frac{\pi\mu_0 e^2\hbar^2}{(m_e)^2 r_n^3} \qquad (2.93)$$

As shown in the Pair Production section with the $v = c$ condition, the result of the substitution of $\alpha a_0 = \lambda_C$ for r_n, the relativistic mass, $2\pi m_e$, for m_e, and multiplication by the relativistic correction, α^{-1}, which arises from Gauss's law surface integral and the relativistic invariance of charge is

$$E_{mag} = m_e c^2 \qquad (2.94)$$

Thus, Eq. (2.92) can be expressed as

$$E_{s/o} = \frac{\alpha^5 (2\pi)^2}{8} m_e c^2 \sqrt{\frac{3}{4}} \qquad\qquad (2.95)$$

The energy called the fine structure splitting is $4.51908 \, X \, 10^{-5} \, eV$ corresponding to a frequency of $10,934.3 \, MHz$ or a wavelength of about $2.7 \, cm$. The $2p_{3/2}$ and $2p_{1/2}$ levels are also split by spin-nuclear and orbital-nuclear coupling. The experimental hyperfine structure transition energy for the $2p_{3/2}$ and $2p_{1/2}$ levels are $23.7 \, MHz$ and $59.19 \, MHz$, respectively. $2p_{3/2}—2p_{1/2}$ transitions occur between hyperfine levels; thus, the transition energy is the sum of the fine structure and the corresponding hyperfine energy. The experimental value of the $2p_{3/2}—2p_{1/2}$ transition is $10,969.1 \, MHz$.

A calculation of the hyperfine lines of hydrino hydride ions due to electron spin-spin magnetic moment coupling similar to one presented in this section is given in the Hydrino Hydride Ion Hyperfine Lines section.

18. Applicant's response to the Secret Committee's contention that "Applicant's linkage of a crisis in quantum mechanics with the shattering of the big bang origin of the universe is erroneous"

The Secret Committee fails to realize that 90% of the visible mass of the universe is hydrogen. The Standard Model is a collection of the many quantum theories: Schrödinger equation, Dirac equation, QED, quantum chromodynamics, Weinberg-Salam, etc. Under the Standard Model, all forces were unified at the instant of the Big Bang. Thus, it is well known that cosmological observations are tests of the Standard Model for forces, families of particles, neutrino mass versus massless, identity of dark matter, etc. The observation of the acceleration of the cosmos challenges the Standard Model since now it must incorporate a new force due to what is now dubbed "dark energy." This has implication for the hydrogen atom since the theory

of the hydrogen atom is part of the Standard Model.

The Secret Committee confuses data regarding the microwave background temperature with that which establishes that the expansion of the Universe is accelerating in contradiction to previous theories.[203]

This recent cosmological observation was also dismissed out of hand by theoreticians who violently opposed the experimentalists since their data disproved their theories. As the data became overwhelming, the theoreticians acquiesced. Overwhelming data summarized in Section I of this Response now establishes the existence of lower-energy hydrogen. Revisions to theory will occur on the basis of data in this instance also. Applicant should not be prejudiced by the Secret Committee's unreasonable convictions to a controversial and flawed theory. Applicant's case should be reviewed based on the data actually observed.

A further extremely relevant point is that Applicant predicted this accelerating expansion of the Universe in 1995, before it was experimentally observed, using a derivation based on Maxwell's equation's—the same equations with which he solved his atomic theory to 11-figure accuracy.[204] Specifically, from R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, Introduction, p. 35:

> For any kind of wave advancing with limiting velocity and capable of transmitting signals, the equation of front propagation is the same as the equation for the front of a light wave. By applying this condition to electromagnetic and gravitational fields at particle production, the Schwarzschild metric (SM) is derived from the classical wave equation which modifies general relativity to include conservation of spacetime in addition to momentum and matter/energy. The result gives a natural relationship between Maxwell's equations, special relativity, and general relativity. It gives gravitation from the atom to the cosmos. The gravitational equations with the equivalence of the particle production energies permit the equivalence of mass/energy and the spacetime wherein a

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[203] Reference 39, at pages 91-101, and Reference 80.

[204] Reference 81.

"clock" is defined that measures "clicks" on an observable in one aspect, and in another, it is the ruler of spacetime of the universe with the implicit dependence of spacetime on matter-energy conversion. The masses of the leptons, the quarks, and nucleons are derived from this metric of spacetime. The universe is time harmonically oscillatory in matter, energy, and spacetime expansion and contraction with a minimum radius that is the gravitational radius. In closed form equations with fundamental constants only, CQM gives the basis of the atomic, thermodynamic, and cosmological arrows of time, the deflection of light by stars, the precession of the perihelion of Mercury, the Hubble constant, the age of the universe, the observed acceleration of the expansion, the power of the universe, the power spectrum of the universe, the microwave background temperature, the uniformity of the microwave background radiation, the microkelvin spatial variation of the microwave background radiation measured by DASI, the observed violation of the GZK cutoff, the mass density of the universe, the large scale structure of the universe, and the identity of dark matter which matches the criteria for the structure of galaxies and spectral lines from interstellar medium and the Sun which have been observed in the laboratory [25-26]. In a special case wherein the gravitational potential energy density of a blackhole equals that of the Planck mass, matter converts to energy and spacetime expands with the release of a gamma ray burst. The singularity in the SM is eliminated.

The results of Applicant's cosmological derivations and consistency with cosmological observations are well documented.[205]

As discussed previously in this Response, quantum mechanics utterly fails at predicting or being consistent with the force of gravity or with cosmological observations.

19. Applicant's response to the Secret Committee's contention that "The Turner and Dhandapani Declarations with respect to NMR experimental data lack probative value"

Dr. Turner was referring to alkali hydrides, not $\beta - Mg_2NiH_4$. Dr. Turner communicated to Applicant at the time of the initial NMR studies that metal hydrides such as transition metal and noble metal hydrides complexes may have upfield shifted peaks, but no saline-like—alkali or alkaline earth metal hydrides—have been reported to have such shifts; nor, had he observed any

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[205] References 27, 28, and 39 at Chapter 23.

such shifts in these class of compounds in his twenty or so years of NMR experience. Dr. Turner also ran the corresponding ordinary alkali and alkaline earth hydrides alone and mixed with the corresponding alkali or alkaline earth halide. No upfield peaks were observed. Only the known peaks of the alkali hydride were observed.

Regarding Dr. Dhandapani and the meaning of "may," since no other explanation existed for the upfield shifted NMR peaks of the alkali and alkaline earth hydrides and halido hydrides that were reproduced at five major independent laboratories, the compounds must have contained novel hydrides ions. Thus, they "may" be hydrino hydrides. This is the standard conservative approach of reporting a new finding adhered to by Dr. Dhandapani. The recent spectroscopic data shown in Section I of this Response absolutely confirms that the novel hydride ions are hydrino hydride ions with binding energies given in Table 1 of the Specification.

Contaminants were considered in the assignment of the upfield shifted peaks. NMR is only responsive to protons. The contaminants present as identified by ToF-SIMS were trace amounts of hydroxide, other halide ions, and other alkali or alkaline earth ions, The ToF-SIMS results were provided to the Secret Committee.[206] None of the alkaline or alkaline earth hydrides produced upfield shifted peaks alone or in combination with halides or hydroxide ions. The NMR peak of the latter was observed at about +4 ppm. The threshold for detection of protons by NMR is about 1% of the sample volume, an unreasonable amount based on the purity of the starting materials and the analysis of the product by ToF-SIMS and XPS. The Secret Committee has presented no prior art that the reported compounds, alkaline and alkaline earth hydrides and halido hydrides have upfield shifted NMR peaks.

The NMR tests were replicated at Spectral Data Services, University of Massachusetts Amherst, University of Delaware, Grace Davison, and National Research Council of Canada.[207]

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[206] References 40 and 42.

[207] Reference 20.

None of these laboratories reported known alkali or alkaline earth hydrides or halido hydrides with upfield shifted NMR peaks. The assignment was confirmed by the recent NMR identification of novel hydride compounds $MH*$ and MH_2^* wherein M is the alkali or alkaline earth metal and $H*$ comprises a novel high binding energy hydride ion identified by a large distinct upfield resonance that proves the hydride ion is different from the hydride ion of the corresponding known compound of the same composition. Furthermore, a number of recent additional tests were performed which unequivocally establish the identification of novel hydrides. The results summarized in Section I of this Response absolutely identify the emission of the novel hydride ions, the characteristic emission from the catalysts, and the novel hydride compounds. For example:

The hydride ions were formed during the catalysis reaction were identified by high resolution spectroscopy. For example, the catalyst product of Rb^+ and two K^+, $H(1/2)$, was predicted to be a highly reactive intermediate which further reacts to form a novel hydride ion $H^-(1/2)$. This hydride ion with a predicted binding energy of 3.0468 eV was observed by high resolution visible spectroscopy as a broad peak at 4070.0 Å with a FWHM of 1.4 Å. From the electron g factor, bound-free hyperfine structure lines of $H^-(1/2)$ were predicted with energies E_{HF} given by $E_{HF} = j^2 3.0056 \times 10^{-5} + 3.0575\ eV$ (j is an integer) as an inverse Rydberg-type series that converges at increasing wavelengths and terminates at 3.0575 eV—the hydride spin-pairing energy plus the binding energy. The high resolution visible plasma emission spectra in the region of 4000 Å to 4060 Å matched the predicted emission lines for $j = 1$ to $j = 37$ to 1 part in 10^5.[208]

The dominant H^- in the negative ion ToF-SIMS spectra confirm the novel hydride compounds.[209]

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[208] References 2 and 7.

[209] References 3, 4, 40, 42 and 43.

The core level shifts of the alkali or alkaline earth metal due to the binding of the hydrino hydride ion confirm the novel alkali and alkaline earth hydrides and halido hydrides.[210]

The hydrino hydride binding energies observed by XPS confirm the novel lower-energy hydrogen compounds.[211]

The novel peaks observed by liquid chromatography/mass spectroscopy confirm the novel compound *KHI*.[212]

Large heats of formation confirm the novel compound *KHI*.[213]

20. Applicant's response to the Secret Committee's contention that "Calorimetric experiments purporting to demonstrate apparent excess heat cannot be accepted uncritically"

Applicant agrees that an accurate calorimetric study of an electrolytic cell requires attention to recombination, heat gradients, careful measurements, etc. Applicant has generated very substantial calorimetric data and uses many tests in addition to calorimetry to confirm Applicant's novel chemistry as summarized in Section I of this Response.

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[210] References 40 and 42.

[211] References 3, 4, and 40-43.

[212] Reference 40.

[213] Reference 24.

21. Applicant's response to the Secret Committee's contention that "Applicant's calorimetric experimental data are not persuasive"

How does the Secret Committee know that the NASA group was receptive to the idea of "hydrinos"? In fact, the report was delayed for two years as strong opponents to "hydrinos" argued against the positive results. In the NASA report,[214] NASA Lewis tested a cell identical to that of Thermacore,[215] with the exception that it was minus the central cathode. A cell identical to the test cell with heater power only (no electrolysis) was the calibration control and the blank cell with the heater power equal to zero. The test cell was also calibrated "on the fly" by measuring the temperature relative to the blank cell at several values of heater input power of the test cell. "Replication of experiments claiming to demonstrate excess heat production in light water-Ni-K2CO3 electrolytic cells was found to produce an apparent excess heat of 11 W maximum, for 60 W electrical power into the cell. Power gains ranged from 1.06 to 1.68." The production of excess energy with a power gain of 1.68 would require 0% Faraday efficiency to account for the observed excess power.

Thermacore is not Applicant's company. It is a well-respected heat transfer company which is now a subsidiary of Modine, a multi billion dollar heat management company. Thermacore's results were published[216] with data obtained at the same time at Applicant's company. Specifically, calorimetry of pulsed current and continuous electrolysis of aqueous potassium carbonate (K^+/K^+ electrocatalytic couple) at a nickel cathode was performed by Thermacore, Inc. The excess power out of 41 watts exceeded the total input power given by the product of the electrolysis voltage and current by a factor greater than 8. Elemental analysis of the electrolyte and metallurgical analysis of the cathode showed no evidence of chemical reactions. The pH, specific gravity, concentration of K_2CO_3, and the elemental analysis of the

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[214] Reference 58.

[215] Reference 47.

[216] Reference 47.

electrolyte sample taken after 42 days of continuous operation were unchanged from that of the values obtained for the electrolyte sample taken before operation. Elemental analysis and scanning electron microscopy of metallurgical samples of the nickel cathode taken before operation and at day 56 of continuous operation were identical indicating that the nickel cathode had not changed chemically or physically. Scintillation counter and photographic film measurements showed that no radiation above background was detected indicating that nuclear reactions did not occur.

The product of the exothermic reaction is atoms having electrons of energy below the "ground state" which are predicted to form molecules. The predicted molecules were identified by lack of reactivity with oxygen, by separation from molecular deuterium by cryofiltration, and by mass spectroscopic analysis. The combustion of the gases evolved during the electrolysis of a light water K_2CO_3 electrolyte (K^+/K^+ electrocatalytic couple) with a nickel cathode was incomplete. The mass spectroscopic analysis of the $m/e = 2$ peak of the combusted gas demonstrated that the dihydrino molecule, $H_2(n = 1/2)$, has a higher ionization energy than H_2.

Calorimetry of pulsed current and continuous electrolysis of aqueous potassium carbonate (K^+/K^+ electrocatalytic couple) at a nickel cathode was performed in single cell dewar calorimetry cells by HydroCatalysis Power Corporation (now BlackLight Power, Inc.). Excess power out exceeded input power by a factor greater than 16. No excess heat was observed when the electrolyte was changed from potassium carbonate to the control sodium carbonate. The faraday efficiency was measured volumetrically to be 100%.

Thermacore measured more heat out that total input power by a factor greater than 8; thus, the heat could not have been due to recombination. The experiment was performed very carefully with temperature gradients eliminated by insuring adequate stirring which was checked. Proper measurement procedures were used. The Thermacore cell was vented through a condensor to eliminate evaporative water losses. The Faraday efficiency was checked. From p. 115:

From the condensed evolving water vapor, the evaporative losses from Experiment # 4 were measured to be 6.5 ml per 24 hours, and 402 ml of water was added to the cell per 24 hours to maintain a constant fill level. The volume consumed by Faraday losses is calculated to be 403 ml. Thus, the evaporative and Faraday losses equaled the maintenance water volume to within 1%.

Their water add back rates were consistent with the cell being close to 100% Faraday efficient which implies that NASA's results were not due to recombination. In fact, the NASA scientists: "Our sparse water addition data thus seems not to entirely favor the recombination explanation."[217]

Since the Thermacore tests, Applicant has analyzed the electrolyte and has confirmed that novel hydride compounds were produced. The excess heat is corroborated by the isolation of novel inorganic hydride compounds such as $KHKHCO_3$ and KH following each of the electrolysis and plasma electrolysis of a K_2CO_3 electrolyte which comprised high binding energy hydride ions that were stable in water with their identification by methods such as (i) ToF-SIMS on $KHKHCO_3$ which showed inorganic hydride clusters $K[KHKHCO_3]_n^+$ and a negative ToF-SIMS dominated by hydride ion, (ii) X-ray photoelectron spectroscopy which showed novel peaks corresponding to high binding energy hydride ions, and (iii) proton nuclear magnetic resonance spectroscopy which showed upfield shifted peaks corresponding to more diamagnetic, high-binding-energy hydride ions.[218]

Recently, Applicant has performed high resolution visible spectroscopy on plasma electrolysis cells. Further confirmation is given by the high resolution visible spectroscopic observation from rt-plasmas and plasma electrolysis cells of the predicted $H^-(1/2)$ ion of hydrogen catalysis by each of K^+/K^+, Rb^+, Cs, and Ar^+ at 407 nm corresponding to its

[217] Reference 58.

[218] References 8, 11, 41, 43 and 44.

predicted binding energy of 3.05 eV.[219]

Independent tests were performed at Westinghouse Corporation that are given in a report: Peterson, S., H., Evaluation of Heat Production from Light Water Electrolysis Cells of HydroCatalysis Power Corporation, Report from Westinghouse STC, 1310 Beulah Road, Pittsburgh, PA, February 25, 1994. In this report, Westinghouse Electric Corporation reports that excess heat was observed during the electrolysis of aqueous potassium carbonate (K^+/K^+ electrocatalytic couple) where the electrolysis of aqueous sodium carbonate served as the control. The data of the temperature of the cell minus the ambient temperature shows that when potassium carbonate replaced sodium carbonate in the same cell with the same input electrolysis power, the potassium experiment was twice as hot as the sodium carbonate experiment for the duration of the experiment, one month. The net faraday efficiency of gas evolution was experimentally measured to be unity by weighing the experiment to determine that the expected rate of water consumption was observed. The output power exceeded the total input power.

The reason for the uncertainty in the comparison of the potassium (catalyst run) with the sodium (control run) was that the potassium cell temperature was so high that a large unaccounted for amount of heat was lost due to evaporation. The skepticism on the part of STC experts regarded whether a 55 eV peak observed in the low binding energy region of the XPS spectrum of the high purity nickel cathode was a predicted hydrino peak or whether the peak was due to iron. The survey scan, which was not available to the STC experts at the time, showed no iron peaks. And, it was later confirmed by ToF-SIMS that iron could not be the source of the novel peak observed.[220]

Since these tests were performed, Applicant has amassed overwhelming evidence of lower-energy hydrogen as summarized in Section I of this Response.

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[219] References 2, 7, 10, 11, 17, 22 and 25.

[220] Reference 82.

Regarding the Wiesmann study, it reports that calorimetry of continuous electrolysis of aqueous potassium carbonate (K^+/K^+ electrocatalytic couple) at a nickel cathode was performed in single cell dewar calorimetry cell by Noninski at Brookhaven National Laboratory.[221] Dr. Weismann observed the experiment and reported the results to Dr. Walter Polansky of the U. S. Department of Energy. Dr. Weismann reports, "The claim is as follows. The temperature rise in the dewar is greater in the case of electrolysis as compared to using a resistor, even though the power dissipated is equal in both cases. According to Applicant's theory, this apparent "excess power" is due to the fact that the electron in a hydrogen atom can "decay" to stable subinteger quantum levels. **Dr. Noninski demonstrated this thermal effect at BNL.**" The observed rise in temperature for a given input power was twice as high comparing electrolysis versus heater power.

Wiesmann was cautious because he did not conduct the experiment himself; although, it was conducted in his laboratory at BNL. The results of the same experiment were published.[222] Dr. Noninski of the Laboratory for Electrochemistry of Renewed Electrode-Solution Interface (LEPGER) successfully reproduced the results of Mills and Kneizys[223] as a visiting professor at Franklin and Marshall College. A significant increase in temperature with every watt input, compared with the calibration experiment ($\approx 50\ °C/W$ versus $\approx 30\ °C/W$), was observed during the electrolysis of potassium carbonate. This effect was not observed when sodium carbonate was electrolyzed. No trivial explanation (in terms of chemical reactions, change in heat transfer properties, etc.) of this effect were found.

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[221] Reference 83.

[222] Reference 59.

[223] Reference 48.

22. Applicant's response to the Secret Committee's contention that "Accurate calorimetric experiment disproves applicant's thesis that apparent excess heat requires an explanation in terms of the postulated hydrino atom"

It is not surprising that some researchers may make mistakes in attempting to perform any arbitrary experiment, including that of Applicant's. The cited experiment was not an identical copy of Applicant's experiment. Shkedi et al. did not fully follow Applicant's procedure. For example, Applicant discloses in Mills, R., Good, W., Shaubach, R., "Dihydrino Molecule Identification", Fusion Technology, Vol. 25, 103 (1994):

> As usual in electrochemistry, measures were taken to avoid impurities in the system, especially organic substances. We note here the known problems with the reproducibility of the hydrogen overpotential which can be overcome only by ensuring the lowest possible level of impurities. The following procedures were applied in order to reproduce the excess heat effect. Before starting the experiment, the electrolysis dewar was cleaned with Alconox and 0.1 M nitric acid and rinsed thoroughly with distilled water to remove all organic contaminants. The Pt anode was mechanically scoured with steel wool, soaked overnight in concentrated HNO_3, and rinsed with distilled water. The nickel cathode was removed from its container with rubber gloves, and cut and folded in such a way that no organic substances were transferred to the nickel surface. The nickel cathode was dipped into the working solution under electrolysis current and never left in the working solution without electrolysis current.

Shkedi et al. did not follow this procedure. If fact, they did exactly that which was advised against. From Z. Shkedi, et al., "Calorimetry, excess heat, and Faraday efficiency in $Ni - H_2O$ electrolytic cells", Fusion Technology, Vol. 28, No. 4, November, (1995), pp. 1720-1731 (page 1722, 1st column):

> The nickel coil assembly was cleaned by soaking it in acetone and methanol and was sintered at 1000°C for 2 hrs in an atmosphere of 95% argon/H_2 at atmospheric pressure.

They also used different materials then those taught by Applicant. Applicant has found that

sintered mesh type materials form a gas boundary layer that prevents the potassium ion catalyst which is in the electrolyte from contacting hydrogen atoms on the surface of the electrode. From Z. Shkedi, et al., "Calorimetry, excess heat, and Faraday efficiency in $Ni - H_2O$ electrolytic cells", Fusion Technology, Vol. 28, No. 4, November, (1995), pp. 1720-1731 (page 1722, 1st column):

> Type B cathodes were made of Fibrex sintered nickel mesh (National Standard, 80% fiber/20% powder) rolled in two layers around the same nickel mandrel as in type a cathodes and secured with two turns of 1-mm nickel wire. Type B cathodes were not cleaned or sintered after assembly.

The Secret Committee states that the observation of recombination by Shkedi et al. implies that Faraday inefficiency may explain excess heat observed by NASA and others. It is important to keep in mind that the cell design of Shkedi et al. was very different from that of NASA and Thermacore. It favored recombination and was in fact designed to recombine all of the gases as a closed calorimeter when operating in that mode. Even so, Tables I-IV of Shkedi et al. show a range of Faraday efficiencies from 73% to 99%. Whereas, 0%, Faraday efficiency was required in order to explain away the NASA results. The Secret Committee offers no other plausible explanation for the 11 W of excess power observed by NASA.

In cases were Applicant was an advisor, Applicant has a 100% track record of independent laboratories reporting an effect. Many of the results of these laboratories could not be attributed to recombination since the observed power was greater than the total input such as:

Mills, R., Good, W., "Fractional Quantum Energy Levels of Hydrogen", Fusion Technology, Vol. 28, No. 4, November, (1995), pp. 1697-1719.

> Excess power and heat were observed during the electrolysis of aqueous potassium carbonate. Flow calorimetry of pulsed current electrolysis of aqueous

potassium carbonate at a nickel cathode was performed in a single-cell dewar. The average power out of 24.6 watts exceeded the average input power (voltage times current) of 4.73 watts by a factor greater than 5. The total input energy (integration of voltage times current) over the entire duration of the experiment was 5.72 MJ; whereas, the total output energy was 29.8 MJ. No excess heat was observed when the electrolyte was changed from potassium carbonate to sodium carbonate.

Mills, R., Good, W., Shaubach, R., "Dihydrino Molecule Identification", Fusion Technology, Vol. 25, 103 (1994).

Calorimetry of pulsed current and continuous electrolysis of aqueous potassium carbonate (K^+/K^+ electrocatalytic couple) at a nickel cathode was performed by Thermacore, Inc. The excess power out of 41 watts exceeded the total input power given by the product of the electrolysis voltage and current by a factor greater than 8. Elemental analysis of the electrolyte and metallurgical analysis of the cathode showed no evidence of chemical reactions. The pH, specific gravity, concentration of K_2CO_3, and the elemental analysis of the electrolyte sample taken after 42 days of continuous operation were unchanged from that of the values obtained for the electrolyte sample taken before operation. Elemental analysis and scanning electron microscopy of metallurgical samples of the nickel cathode taken before operation and at day 56 of continuous operation were identical indicating that the nickel cathode had not changed chemically or physically. Scintillation counter and photographic film measurements showed that no radiation above background was detected indicating that nuclear reactions did not occur.

Calorimetry of pulsed current and continuous electrolysis of aqueous potassium carbonate (K^+/K^+ electrocatalytic couple) at a nickel cathode was performed in single cell dewar calorimetry cells by HydroCatalysis Power Corporation. Excess power out exceeded input power by a factor greater than 16. No excess heat was observed when the electrolyte was changed from potassium carbonate to the control sodium carbonate. The faraday efficiency was measured volumetrically to be 100%.

R. Mills and S. Kneizys, Fusion Technol. Vol. 20, 65 (1991).

Calorimetry of pulsed current and continuous electrolysis of aqueous potassium carbonate (K^+/K^+ electrocatalytic couple) at a nickel cathode was performed in single cell dewar calorimetry cells by Mills of Franklin and Marshall College and Kneizys of Ursinus College. Excess power out exceeded the input power by a factor greater than 37. No excess heat was observed when the electrolyte was changed from potassium carbonate to the control sodium

carbonate.

Jacox, M. G., Watts, K. D., "The Search for Excess Heat in the Mills Electrolytic Cell", Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, Idaho, 83415, January 7, 1993.

Idaho National Engineering Laboratory (INEL) operated a cell identical to that of Thermacore[224] except that it was minus the central cathode and that the cell was wrapped in a one-inch layer of urethane foam insulation about the cylindrical surface. The cell was operated in a pulsed power mode. A current of 10 amperes was passed through the cell for 0.2 seconds followed by 0.8 seconds of zero current for the current cycle. The cell voltage was about 2.4 volts, for an average input power of 4.8 W. The electrolysis power average was 1.84 W, and the stirrer power was measured to be 0.3 W. Thus, the total average net input power was 2.14 W. The cell was operated at various resistance heater settings, and the temperature difference between the cell and the ambient as well as the heater power were measured. The results of the excess power as a function of cell temperature with the cell operating in the pulsed power mode at 1 Hz with a cell voltage of 2.4 volts, a peak current of 10 amperes, and a duty cycle of 20 % showed that the excess power is temperature dependent for pulsed power operation, and the maximum excess power was 18 W for an input electrolysis joule heating power of 2.14 W. Thus, the ratio of excess power to input electrolysis joule heating power was 850 %. INEL scientists constructed an electrolytic cell comprising a nickel cathode, a platinized titanium anode, and a 0.57 M K_2CO_3 electrolyte. The cell design appears in Appendix 1. The cell was operated in the environmental chamber in the INEL Battery Test Laboratory at constant current, and the heat was removed by forced air convection in two cases. In the first case, the air was circulated by the environmental chamber circulatory system alone. In the second case, an additional forced air fan was directed onto the cell. The cell was equipped with a water condenser, and the water addition to the cell due to electrolysis losses was measured. The data of the forced convection heat loss calorimetry experiments during the electrolysis of a 0.57 M K_2CO_3 electrolyte with the INEL cell showed that 13 W of excess power was produced. This excess power could not be attributed to recombination of the hydrogen and oxygen as indicated by the equivalence of the calculated and measured water balance.

Nesterov, S. B., Kryukov, A. P., Moscow Power Engineering Institute Affidavit, February, 26,1993.

The Moscow Power Engineering Institute experiments showed 0.75 watts of heat output with only 0.3 watts of total power input (power = VI) during the

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[224] Reference 47.

electrolysis of an aqueous potassium carbonate electrolyte with a nickel foil cathode and a platinized titanium anode. Excess power over the total input on the order of 0.45 watts was produced reliably and continuously over a period of three months. Evaluation of the electrolyte after three months of operation showed no significant change in its density or molar concentration. The cell was disassembled and inspected after over one month of operation at 0.1 amperes. This inspection showed no visible signs of a reaction between the electrodes and the electrolyte. The cell was re-assembled and operated as before. Excess energy was produced for the three month duration of the experiment. Scintillation counter measurements showed no signs of radiation external to the cell.

Haldeman, C. W., Savoye, G. W., Iseler, G. W., Clark, H. R., MIT Lincoln Laboratories Excess Energy Cell Final report ACC Project 174 (3), April 25, 1995.

During the electrolysis of aqueous potassium carbonate, researchers working at MIT Lincoln Laboratories observed long duration excess power of 1-5 watts with output/input ratios over 10 in some cases with respect to the cell input power reduced by the enthalpy of the generated gas. In these cases, the output was 1.5 to 4 times the integrated volt-ampere power input. Faraday efficiency was measured volumetrically by direct water displacement.

Excess heat was also observed in a closed cell:

Craw-Ivanco, M. T.; Tremblay, R. P.; Boniface, H. A.; Hilborn, J. W.; "Calorimetry for a Ni/K_2CO_3 Cell", Atomic Energy Canada Limited, Chemical Engineering Branch, Chalk River Laboratories, Chalk River, Ontario, June 1994.

Atomic Energy Canada Limited, Chalk River Laboratories, report that 128% and 138% excess heat were observed in separate experiments by flow calorimetry during the electrolysis of aqueous potassium carbonate (K+/K+ electrocatalytic couple) in a closed cell, and that 138% was observed in an open cell.

Since these electrolysis experiments, Applicant has advanced to plasma cells which produce a power density as high as 1000 times that achieved in the electrolysis cells. In this case, the calorimetry is trivial. A summary of equivocal measurement of power is given in Section I of this Response. Line broadening, electron temperature, high energy spectroscopic lines corresponding to lower-energy hydrogen species and the analysis and characterization of the novel hydrogen products confirm the calorimetry as given in Section I of this Response. In

addition, a plasma was observed when all power has been removed from the cell that lasted for a time that was 1000 times the typical plasma decay time which proves a new energy source.[225]

23. Applicant's response to the Secret Committee's contention that "The Phillips Declaration with respect to hydrino formation in a calorimeter lacks probative value"

Philips results are given in a report:

> **Phillips, J., Smith, J., Kurtz, S., "Report On Calorimetric Investigations Of Gas-Phase Catalyzed Hydrino Formation" Final report for Period October-December 1996", January 1, 1997, A Confidential Report submitted to BlackLight Power, Inc. provided by BlackLight Power, Inc., Great Valley Corporate Center, 41 Great Valley Parkway, Malvern, PA 19355.**
>
> Pennsylvania State University Chemical Engineering Department has determined heat production associated with hydrino formation with a Calvet calorimeter which yielded exceptional results. Specifically, the results are completely consistent with Mills hydrino formation hypothesis. In three separate trials, between 10 and 20 K Joules were generated at a rate of 0.5 Watts, upon admission of approximately 10^{-3} moles of hydrogen to the 20 cm^3 Calvet cell containing a heated platinum filament and KNO_3 powder. This is equivalent to the generation of 10^7 $J/mole$ of hydrogen, as compared to 2.5×10^5 $J/mole$ of hydrogen anticipated for standard hydrogen combustion. Thus, the total heats generated appear to be 100 times too large to be explained by conventional chemistry, but the results are completely consistent with Mills model.

EarthTech, promotes "infinite energy from vacuum" which Applicant finds incredulous. Applicant was contacted by Scott Little of EarthTech under the following pretext:

Scott Little Email of 3/2/99:

> Although it would appear that you have sufficient funding and business structure in place, we are in a position to bring to the table essentially unlimited financial resources from a private investor with excellent connections in the international community. We consider this one of our most valuable resources with regard to a smooth transition to a new energy economy.

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[225] References 1, 36 and 37.

Scott R. Little
Harold E. Puthoff

Puthoff is a promoter of "infinite energy from the vacuum" which he claims can be used for power generation, space propulsion as well as explain the stability of the hydrogen atom. He is also the President/CEO of EarthTech International, Inc.

Puthoff, H.E. , "THE ENERGETIC VACUUM: IMPLICATIONS FOR ENERGY RESEARCH" Speculations in Science and Technology, vol. 13, no. 4, pp. 247-257, 1990.

Puthoff, H.E. , "Gravity as a Zero-Point-Fluctuation Force", Physical Review A, vol. 39, no. 5, pp. 2333-2342, 1 March 1989.

Puthoff, H.E. , "Source of Vacuum Electromagnetic Zero-Point Energy", Physical Review A, vol. 40, no. 9, pp. 4857-4862, 1 November 1989.

Puthoff, H.E. , Review A, vol. 44, no. 5, page 3382 and 3385-3386, and an Erratum in Physical Review A, vol. 41, no. 5, page 2902.

Puthoff, H.E. , "Everything for Nothing", New Scientist, pp. 52-55, 28 July 1990.

Puthoff, H.E. , "Everything for Nothing"
http://www.newphys.se/elektromagnum/physics/Puthoff/
Everything%20for%20Nothing.

Puthoff, H.E., "Can the Vacuum be Engineered for Spaceflight applications?"
http://www.keelynet.com/gravity/putnasa.htm.

Puthoff, H.E. (1987) "Ground state of hydrogen as a zero-point-fluctuation determined state", Phys. Rev. D, Vol. 35, No. 10, pp. 3266-3269.

Also see:

Interview with possible Roswell witness on 07 January 1993
by H.E. Puthoff, Institute of Advanced Studies, Austin, TX
http://www.ufomind.com/misc/1997/jul/d26-001.shtml

Earth Tech is a competitor that Applicant believes is adversarial. It is possible that they have provided misinformation. Applicant was unaware of the incorrect specifications sourced to EarthTech by the Secret Committee. However, on inspection of the document: "EarthTech's

campaign to replicate one of the BlackLight Power excess heat results", on page 3, of the "BLP gas phase replication effort-Run 13" Applicant reads "**our** [emphasis added] detection limit for excess should be put at about 1 or 2 watts"; thus, it appears that the Secret Committee carelessly erred in applying the specifications of EarthTech's instrument to the interpretation of Phillips' data.

Dr. Phillips' expert technical capability is established in the Declaration, see sections 1, 2, and 3. Clearly, a person of his stature and knowledge would not make statements beyond the capability of the instrument. In fact, Phillips has published several peer reviewed papers using this calorimeter. For example, a description of the calorimeter is in Dr. Phillips's paper entitled, "High-temperature Calvet-type calorimeter for Investigating water reactions", Review of Scientific Instruments, Vol. 66 (1), January, 1995. In this paper the calorimeter is calibrated, see Figure 4, and the calorimeter demonstrated the ability to measure tenths of joules. In Dr. Phillips' affidavit, the energy measured from BLP materials was stated as 31,000 joules. The energy reported in the affidavit is greater than 100 times the signal to noise for the instrument. In addition, the January 1996 report contains two finger tests that were performed prior to experimentation, see figures 21-1 and 22-1. These finger tests clearly demonstrate the signal to noise characteristics of the instrument. In the same report, the energy balance is stated to hundredths of joules for the experiments, providing further guidance to the sensitivity of the instrument.

Thus, the Secret Committee's position of the rejection the affidavit from a Dr. Phillips who is a Distinguished National Laboratory Professor at the University of New Mexico, Department of Chemical and Nuclear Engineering and a scientists at Los Alamos National Laboratory based on improper information from a third party competitor or a careless error is shown to be erroneous.

The lack of success with the water bath calorimeter is indeed positive evidence of the catalysis mechanism. The catalysts condensed on the cold walls and was not operative according

to Applicant's expectations. This explanation was also offered by Phillips.

24. Applicant's response to the Secret Committee's contention that "spectroscopic and plasma experimental data are not persuasive"

The skepticism on the part of STC experts regarded whether a 55 eV peak observed in the low binding energy region of the XPS spectrum of the high purity nickel cathode was a predicted hydrino peak or whether the peak was due to iron. The survey scan, which was not available to the STC experts until a later date, showed no iron peaks. And, it was later confirmed by ToF-SIMS that iron could not be the source of the novel peak observed.[226]

The Secret Committee is mistaken as to what is identified in figure 17, for example. The identified hydride ion $H^-(1/p)$ peaks correspond to their predicted binding energies which are given in Table 1 of the Application. They do not correspond transitions between different orbitals or energy levels. Furthermore, the peaks should have low intensity since the cross section for the ionizing X-rays is proportional to the radius of the atom squared, and the radius of the hydrino hydride ions are much smaller than the radii of the other elements present such as potassium. Extensive data which confirm hydrino hydride ions by XPS is summarized in Section I of this Response.

From page 3, line 31 through page 4, line 5 of the present specification, Applicant discloses:

This invention is directed to a new composition of matter comprising a hydride ion (H^-) having a binding energy greater than $0.8\ eV$, as reflected in the following formula

$$Binding\ Energy = \frac{\hbar^2\sqrt{s(s+1)}}{8\mu_e a_0^2\left[\frac{1+\sqrt{s(s+1)}}{p}\right]^2} - \frac{\pi\mu_0 e^2\hbar^2}{m_e^2 a_0^3}\left(1+\frac{2^2}{\left[\frac{1+\sqrt{s(s+1)}}{p}\right]^3}\right) \qquad (1)$$

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[226] Reference 82.

where p is an integer greater than one, $s = 1/2$, π is pi, $\hbar$ is Planck's constant bar, μ_o is the permeability of vacuum, m_e is the mass of the electron, μ_e is the reduced electron mass, a_o is the Bohr radius, and e is the elementary charge.

From page 6, lines 1-25 of the present specification, Applicant discloses:

TABLE 1. The representative binding energy of the hydrino hydride ion $H^-(n = 1/p)$ as a function of p, Eq. (1).

Hydride Ion	r_1 (a_o)[a]	Binding Energy[b] (eV)	Wavelength (nm)
$H^-(n = 1/2)$	0.9330	3.047	407
$H^-(n = 1/3)$	0.6220	6.610	188
$H^-(n = 1/4)$	0.4665	11.23	110
$H^-(n = 1/5)$	0.3732	16.70	74.2
$H^-(n = 1/6)$	0.3110	22.81	54.4
$H^-(n = 1/7)$	0.2666	29.34	42.3
$H^-(n = 1/8)$	0.2333	36.08	34.4
$H^-(n = 1/9)$	0.2073	42.83	28.9
$H^-(n = 1/10)$	0.1866	49.37	25.1
$H^-(n = 1/11)$	0.1696	55.49	22.3
$H^-(n = 1/12)$	0.1555	60.97	20.3
$H^-(n = 1/13)$	0.1435	65.62	18.9
$H^-(n = 1/14)$	0.1333	69.21	17.9
$H^-(n = 1/15)$	0.1244	71.53	17.3
$H^-(n = 1/16)$	0.1166	72.38	17.1

[a] Equation (21), *infra.*
[b] Equation (22), *infra.*

These hydride ions are now identified definitively by recent XPS data and additional methods such as high resolution visible spectroscopy as summarized in Section I of this Response.

For example, the catalyst product of Rb^+ and two K^+, $H(1/2)$, was predicted to be a highly reactive intermediate which further reacts to form a novel hydride ion $H^-(1/2)$. This hydride ion with a predicted binding energy of $3.0468\ eV$ was observed by high resolution visible spectroscopy as a broad peak at 4070.0 Å with a FWHM of 1.4 Å. From the electron g factor, bound-free hyperfine structure lines of $H^-(1/2)$ were predicted with energies E_{HF} given by $E_{HF} = j^2 3.0056\ X\ 10^{-5} + 3.0575\ eV$ (j is an integer) as an inverse Rydberg-type series that converges at increasing wavelengths and terminates at $3.0575\ eV$—the hydride spin-pairing energy plus the binding energy. The high resolution visible plasma emission spectra in the region of 4000 Å to 4060 Å matched the predicted emission lines for $j = 1$ to $j = 37$ to 1 part in 10^5.[227]

The Secret Committee's position that Applicant's plasma which forms at 2 V can not be due to energy tapped off from lower-energy hydrogen formation is based on the false premise that Applicant has not shown lower-energy hydrogen production. Applicant, however, has in fact demonstrated that electrons with fractional quantum numbers do exist.[228] Studies that experimentally confirm Applicant's novel reaction of atomic hydrogen which produces hydrogen in fractional quantum states that are at lower energies than the traditional "ground" ($n = 1$) state, a chemically generated or assisted plasma (rt-plasma), and produces novel hydride compounds are described in detail in Section 1. A brief summary includes:

extreme ultraviolet (EUV) spectroscopy,

characteristic emission from catalysis and the hydride ion products,

lower-energy hydrogen emission,

plasma formation,

Balmer α line broadening,

elevated electron temperature,

anomalous plasma afterglow duration,

power generation, and

analysis of chemical compounds.

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[227] References 2 and 7.

[228] Reference 32.

To assist the Secret Committee to understand the novel catalytic reaction of atomic hydrogen of the present invention an excerpt from R. L. Mills, P. Ray, " High Resolution Spectroscopic Observation of the Bound-Free Hyperfine Levels of a Novel Hydride Ion Corresponding to a Fractional Rydberg State of Atomic Hydrogen", Int. J. Hydrogen Energy, in press, is provided:

I. INTRODUCTION

A. Background

J. J. Balmer showed in 1885 that the frequencies for some of the lines observed in the emission spectrum of atomic hydrogen could be expressed with a completely empirical relationship. This approach was later extended by J. R. Rydberg, who showed that all of the spectral lines of atomic hydrogen were given by the equation:

$$\bar{v} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) \tag{1}$$

where $R = 109,677 \ cm^{-1}$, $n_f = 1,2,3,...$, $n_i = 2,3,4,...$, and $n_i > n_f$.

Niels Bohr, in 1913, developed a theory for atomic hydrogen that gave the energy levels in agreement with Rydberg's equation. An identical equation, based on a totally different theory for the hydrogen atom, was developed by E. Schrodinger, and independently by W. Heisenberg, in 1926.

$$E_n = -\frac{e^2}{n^2 8\pi\varepsilon_o a_H} = -\frac{13.598 \ eV}{n^2} \tag{2a}$$

$$n = 1,2,3,... \tag{2b}$$

where a_H is the Bohr radius for the hydrogen atom ($52.947 \ pm$), e is the magnitude of the charge of the electron, and ε_o is the vacuum permittivity.

The excited energy states of atomic hydrogen are given by Eq. (2a) for $n > 1$ in Eq. (2b). The $n = 1$ state is the "ground" state for "pure" photon transitions (the $n = 1$ state can absorb a photon and go to an excited electronic state, but it cannot release a photon and go to a lower-energy electronic state). However, an electron transition from the ground state to a lower-energy state may be possible by a nonradiative energy transfer such as multipole coupling or a resonant collision mechanism. Processes such as hydrogen molecular bond formation that occur without photons and that require collisions are common [1]. Also, some commercial phosphors are based on resonant nonradiative energy transfer involving multipole coupling [2].

We propose that atomic hydrogen may undergo a catalytic reaction with

certain atomized elements and ions which singly or multiply ionize at integer multiples of the potential energy of atomic hydrogen, $m \cdot 27.2\ eV$ wherein m is an integer. The theory and supporting data was given previously [3-37]. The reaction involves a nonradiative energy transfer to form a hydrogen atom that is lower in energy than unreacted atomic hydrogen called a *hydrino* that corresponds to a fractional principal quantum number. That is

$$n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, ..., \frac{1}{p}; \quad p \text{ is an integer} \tag{2c}$$

replaces the well known parameter n = integer in the Rydberg equation for hydrogen excited states. The $n = 1$ state of hydrogen and the $n = \dfrac{1}{\text{integer}}$ states of hydrogen are nonradiative, but a transition between two nonradiative states is possible via a nonradiative energy transfer, say $n = 1$ to $n = 1/2$. In these cases, during the transition the electron couples to another electron transition, electron transfer reaction, or inelastic scattering reaction which can absorb the exact amount of energy that must be removed from the hydrogen atom to cause the transition. Thus, a catalyst provides a net positive enthalpy of reaction of $m \cdot 27.2\ eV$ (i.e. it absorbs $m \cdot 27.2\ eV$ where m is an integer). Certain atoms or ions serve as catalysts which resonantly accept the nonradiative energy transfer from hydrogen atoms and release the energy to the surroundings to affect electronic transitions to fractional quantum energy levels. As a consequence of the nonradiative energy transfer, the hydrogen atom becomes unstable and emits further energy until it achieves a lower-energy nonradiative state having a principal energy level given by Eqs. (2a) and (2c).

B. rt-plasma

It was reported previously that a new plasma source has been developed that operates by incandescently heating a hydrogen dissociator to provide atomic hydrogen and heats a catalyst such that it becomes gaseous and reacts with the atomic hydrogen to produce a rt-plasma. It was extraordinary, that intense EUV emission was observed by Mills et al. [11, 13-15, 23-24, 26-27] at low temperatures (e.g. $\approx 10^3\ K$) from atomic hydrogen and certain atomized elements or certain gaseous ions which singly or multiply ionize at integer multiples of the potential energy of atomic hydrogen, $27.2\ eV$ that comprise catalysts. The only pure elements that were observed to emit EUV were those wherein the ionization of t electrons from an atom to a continuum energy level is such that the sum of the ionization energies of the t electrons is approximately

$$m \cdot 27.2\ eV \tag{3}$$

where t and m are each an integer. Alternatively, a catalyst depended on the transfer of t electrons between participating ions such that the transfer of t electrons from one ion to another ion provides a net enthalpy of reaction whereby the sum of the ionization energy of the electron donating ion minus the ionization

energy of the electron accepting ion equals approximately $m \cdot 27.2 \ eV$.

Since Ar^+ and strontium each ionize at an integer multiple of the potential energy of atomic hydrogen, a discharge with one or more of these species present with hydrogen was anticipated to form a rt-plasma wherein the plasma forms by a resonance transfer mechanism involving the species providing a net enthalpy of a multiple of 27.2 eV and atomic hydrogen.

Mills and Nansteel [11, 16-17, 23] have reported that strontium atoms each ionize at an integer multiple of the potential energy of atomic hydrogen and caused emission. (The enthalpy of ionization of Sr to Sr^{5+} has a net enthalpy of reaction of 188.2 eV, which is equivalent to $m = 7$.) The emission intensity of the plasma generated by atomic strontium increased significantly with the introduction of argon gas only when Ar^+ emission was observed. Whereas, no emission was observed when chemically similar atoms that do not ionize at integer multiples of the potential energy of atomic hydrogen (sodium, magnesium, or barium) replaced strontium with hydrogen, hydrogen-argon mixtures, or strontium alone.

Mills and Nanstell [16-17, 23] measured the power balance of a gas cell having vaporized strontium and atomized hydrogen from pure hydrogen or argon-hydrogen mixture (77/23%) by integrating the total light output corrected for spectrometer system response and energy over the visible range. Hydrogen control cell experiments were identical except that sodium, magnesium, or barium replaced strontium. In the case of hydrogen-sodium, hydrogen-magnesium, and hydrogen-barium mixtures, 4000, 7000, and 6500 times the power of the hydrogen-strontium mixture was required, respectively, in order to achieve that same optically measured light output power. With the addition of argon to the hydrogen-strontium plasma, the power required to achieve that same optically measured light output power was reduced by a factor of about two. The power required to maintain a plasma of equivalent optical brightness with strontium atoms present was 8600 and 6300 times less than that required for argon-hydrogen and argon control, respectively. A plasma formed at a cell voltage of about 250 V for hydrogen alone and sodium-hydrogen mixtures, 140-150 V for hydrogen-magnesium and hydrogen-barium mixtures, 224 V for an argon-hydrogen mixture, and 190 V for argon alone; whereas, a plasma formed for hydrogen-strontium mixtures and argon-hydrogen-strontium mixtures at extremely low voltages of about 2 V and 6.6 V, respectively.

It was reported [15] that characteristic emission was observed from a continuum state of Ar^{2+} which confirmed the resonant nonradiative energy transfer of 27.2 eV from atomic hydrogen Ar^+. The transfer of 27.2 eV from atomic hydrogen to Ar^+ in the presence of a electric weak field resulted in its excitation to a continuum state. Then, the energy for the transition from

essentially the Ar^{2+} state to the lowest state of Ar^+ was predicted to give a broad continuum radiation in the region of 456 Å. This broad continuum emission was observed. This emission was dramatically different from that given by an argon microwave plasma wherein the entire Rydberg series of lines of Ar^+ was observed with a discontinuity of the series at the limit of the ionization energy of Ar^+ to Ar^{2+}. The observed Ar^+ continuum in the region of 456 Å confirmed the rt-plasma mechanism of the excessively bright, extraordinarily low voltage discharge. The product hydride ion with Ar^+ as a reactant was predicted to have a binding energy of 3.05 eV and was observed spectroscopically at 4070 Å [11, 15].

THE CATALYSTS MECHANISM HAS BEEN CONFIRMED SPECTROSCOPICALLY FOR HELIUM ION, RUBIDIUM ION, POTASSIUM ATOM AND TWO POTASSIUM IONS, ARGON ION, AND CESIUM ATOM BY THE OBSERVATION OF THE FORMATION OF THE PREDICTED OXIDATION STATES OF THE CATALYST WHICH CAN NOT BE ORDINARILY EXPLAINED UNDER THE OPERATING CONDITIONS OF THE CELL, BY CHARACTERISTIC EMISSION FROM THE CATALYSTS, AND BY SPECTROSCOPIC IDENTIFICATION OF LOWER-ENERGY ATOMIC, MOLECULAR ION, OR HYDRIDE IONS AS SUMMARIZED IN SECTION I OF THIS RESPONSE.

Strontium may serve as a catalyst since it can provide a net enthalpy of reaction of an integer multiple of that the potential energy of atomic hydrogen. The first through the fifth ionization energies of strontium are 5.69484 eV, 11.03013 eV, 42.89 eV, 57 eV, and 71.6 eV, respectively.[229] The ionization reaction of Sr to Sr^{5+}, ($t=5$), then, has a net enthalpy of reaction of 188.2 eV, which is equivalent to $7 \cdot 27.2\ eV$ with in experimental error of the published ionization energies for strontium.

$$188.2\ eV + Sr(m) + H\left[\frac{a_H}{p}\right] \rightarrow Sr^{5+} + 5e^- + H\left[\frac{a_H}{(p+7)}\right] + [(p+7)^2 - p^2]X13.6\ eV \qquad (6)$$

$$Sr^{5+} + 5e^- \rightarrow Sr(m) + 188.2\ eV \qquad (7)$$

And, the overall reaction is

$$H\left[\frac{a_H}{p}\right] \rightarrow H\left[\frac{a_H}{(p+7)}\right] + [(p+7)^2 - p^2]X13.6 \ eV \qquad (8)$$

The oxidation state in which strontium is commonly found in inorganic compounds is irrelevant to the present catalytic reaction since it only involves a resonance between atomic hydrogen and strontium without any regard to the formation of stable inorganic compounds such as strontium chloride.

The identification of Sr^{5+} is experimentally challenging due to required detection at very short wavelengths. The formation of a hydrogen plasma with atomic hydrogen and atomic strontium with no plasma from controls such as magnesium supports that Sr^{5+} is acting as a catalyst since no conventionsl explanation of the data can be found. The Secret Committee provides no alternative basis for the formation of a hydrogen plasma by heating strontium with atomic hydrogen or for the formation of a discharge at 2 V with strontium and hydrogen present.

The wave equation used is the same as the time dependent rigid rotor equation of quantum mechanics that results from applying the constraint of nonradiation to the three dimension wave equation plus time. Furthermore, in R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, Introduction, Applicant demonstrates how the Schrodinger equation can be made compliant with first principals and further reveals the relationship between Applicant's theory based on physics and the tradition quantum mechanical approach that based on probability waves. This is also discussed in Section 17 of this Response. The lower-energy hydrogen transitions have been observed spectroscopically as summarized in Section I of this Response.

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[229] Reference 85.

The independent work performed at Institut fur Niedertemperatur-Plasmaphysik e.V. was supported by Applicant. However, to suggest that the Director and Chairman of the Board of one Germany's most prestigious National Laboratories, once headed by two Noble Laureates Stark and Mie, would compromise his scientific integrity is unreasonable.

Applicant currently has 50 papers submitted for publication of which 34 are accepted for publication or published. To better educate the Secret Committee about Applicant's publications, "in press" means that the journal article has been through rigorous peer review, that the additional experiments and changes required by the referees have been made and that they were accepted by the referees and the Editors. "Submitted" means that Applicant and his 11 Ph.D.'s and other technical staff believe that the paper is scientifically correct, represents a significant scientific advancement, and will be published.

It is standard practice for those holding to rigorous scientific due process to submit their result for peer review. Publication confers that the methods are scientifically sound in the view of the referees. Given that 34 papers are accepted or published, Applicant has not only met the new burden required by the Secret Committee, but has exceeded it. The Secret Committee has an obligation to analyze the new data, which dictates allowance of the subject application. The scientific results are sound and comprehensive and overwhelmingly demonstrate the validity of Applicant's Invention.

In Applicant's last interview with the PTO, Secret Committee Member Jagannathan stated that he required that Applicant's technology be published in peer-reviewed journals before he would allow a patent to issue. Applicant's theory has been peer reviewed and is published or is currently being published in at least four articles. The experimental test results are the basis of the 50 articles listed and described in the REFERENCE section of Section I of this Response.

Applicant has more than met his burden, and all of the new burdens newly coined by the Secret Committee, especially in light that this is an extraordinary amount of compressive and

sophisticated material which is not required to be published under patent law. The standards which are being applied to Applicant are UNPRECEDENTED AND UNREASONABLE.

25. Applicant's response to the Secret Committee's contention that "The Mills Declaration with respect to extreme ultraviolet spectroscopic data lacks probative value"

Section 24 of this Response, Applicant's theory[230] and the articles referenced in Section I of this Response clearly demonstrate that the catalysts mechanism is not only plausible, but is, in fact, operable. The Secret Committee clearly does not understand the mechanism. Applicant is not trying "to force a match between the input and output of energy." A resonance exists between He^+ and atomic hydrogen. That is why helium ion is selected as a catalyst. The same applies for the case of strontium. Only certain ions and atoms provide a reaction that has a net enthalpy of an integer multiple of the potential energy of atomic hydrogen.

For example, the first, second, and third ionization energies of potassium are 4.34066 eV, 31.63 eV, and 45.806 eV, respectively. The triple ionization ($t = 3$) reaction of K to K^{3+}, then, has a net enthalpy of reaction of 81.7766 eV, which is equivalent to $3 \cdot 27.2$ eV. Potassium is readily available from chemical supply companies such as Alpha Aesar. This is heated to form gaseous potassium atoms in the cell. The potassium atoms react with atomic hydrogen produced by dissociation at a hot filament for example. A hydrogen atom transfers 81.6 eV to a potassium atom which is ionized to K^{3+} due to the RESONANT NONRADIATIVE ENERGY TRANSFER. The K^{3+} ion is unequivocally observed spectroscopically.[231] The Secret Committee has offered no basis or explanation of the formation of K^{3+} at 700 °C. Lower energy hydrogen is formed as indicated by the formation of a plasma due to the energy release, and a novel hydride ion is formed with a binding energy of 11 eV corresponding to the observed

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[230] Reference 39 at Chapter 5.

[231] Reference 22.

emission at 110 nm.[232] Novel hydride compounds are formed.[233] A large enthalpy of formation of the hydrides is observed.[234] No energy match is forced, as misunderstood by the Secret Committee.

In order to better educate the Secret Committee about Applicant's catalytic reaction, the following excerpt is provided. From R. L. Mills, P. Ray, B. Dhandapani, M. Nansteel, X. Chen, J. He, "New Power Source from Fractional Rydberg States of Atomic Hydrogen", Chem. Phys. Letts., submitted:

1. Introduction

J. R. Rydberg showed that all of the spectral lines of atomic hydrogen were given by a completely empirical relationship:

$$\overline{v} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) \tag{1}$$

where $R = 109,677 \ cm^{-1}$, $n_f = 1,2,3,...$, $n_i = 2,3,4,...$ and $n_i > n_f$. Bohr, Schrodinger, and Heisenberg each developed a theory for atomic hydrogen that gave the energy levels in agreement with Rydberg's equation.

$$E_n = -\frac{e^2}{n^2 8\pi\varepsilon_o a_H} = -\frac{13.598 \ eV}{n^2} \tag{2a}$$

$$n = 1,2,3,... \tag{2b}$$

The excited energy states of atomic hydrogen are given by Eq. (2a) for $n > 1$ in Eq. (2b). The $n = 1$ state is the "ground" state for "pure" photon transitions (i.e. the $n = 1$ state can absorb a photon and go to an excited electronic state, but it cannot release a photon and go to a lower-energy electronic state). However, an electron transition from the ground state to a lower-energy state may be possible by a resonant nonradiative energy transfer such as multipole coupling or a resonant collision mechanism. Processes such as hydrogen molecular bond formation that occur without photons and that require collisions are common [1]. Also, some commercial phosphors are based on resonant nonradiative energy transfer involving multipole coupling [2].

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[232] References 7 and 22.

[233] References 20, 40 and 42.

[234] Reference 24.

We propose that atomic hydrogen may undergo a catalytic reaction with certain atoms and ions such as He^+ which singly or multiply ionize at integer multiples of the potential energy of atomic hydrogen, $m \cdot 27.2 \ eV$ wherein m is an integer. The theory was given previously [3-5]. The reaction involves a nonradiative energy transfer to form a hydrogen atom that is lower in energy than unreacted atomic hydrogen that corresponds to a fractional principal quantum number. That is

$$n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, ..., \frac{1}{p} \ ; \quad p \text{ is an integer} \tag{2c}$$

replaces the well known parameter n = integer in the Rydberg equation for hydrogen excited states. The $n = 1$ state of hydrogen and the $n = \dfrac{1}{\text{integer}}$ states of hydrogen are nonradiative, but a transition between two nonradiative states is possible via a nonradiative energy transfer, say $n = 1$ to $n = 1/2$. Thus, a catalyst provides a net positive enthalpy of reaction of $m \cdot 27.2 \ eV$ (i.e. it resonantly accepts the nonradiative energy transfer from hydrogen atoms and releases the energy to the surroundings to affect electronic transitions to fractional quantum energy levels). As a consequence of the nonradiative energy transfer, the hydrogen atom becomes unstable and emits further energy until it achieves a lower-energy nonradiative state having a principal energy level given by Eqs. (2a) and (2c).
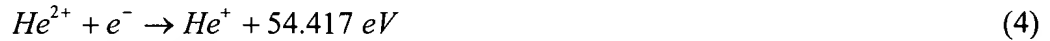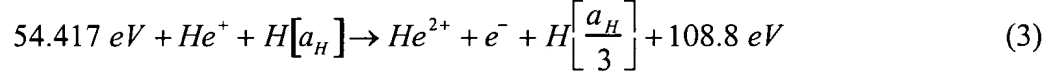
A. EUV Spectroscopy

In the case of the EUV spectrum of hydrogen, xenon, or xenon-hydrogen (98/2%), no peaks were observed below $78 \ nm$, and no spurious peaks or artifacts due to the grating or the spectrometer were observed. Only known He I and He II peaks were observed in the EUV spectrum of the control helium microwave discharge cell emission.

The EUV spectra ($17.5 - 50 \ nm$) of the microwave cell emission of the helium-hydrogen mixture (98/2%) (top curve) and the helium control (bottom curve) are shown in Figure 1. Ordinary hydrogen has no emission in these regions. Novel peaks were observed at $45.6 \ nm$, $37.4 \ nm$, and $20.5 \ nm$ which do not correspond to helium. At the 1 Torr condition, additional novel peaks were observed in the short wavelength region ($5 - 65 \ nm$) at $14.15 \ nm$, $13.03 \ nm$, $10.13 \ nm$, and $8.29 \ nm$ which do not correspond to helium as shown in Figure 1. Known He I lines which were used for calibration of the novel peak positions were observed at $58.4 \ nm$, $53.7 \ nm$, and $52.4 \ nm$. It is proposed that the $30.4 \ nm$ peak shown in Figures 1 and 2 was not entirely due to the He II transition. In the case of the helium-hydrogen mixture, the ratio of $30.4 \ nm$ ($40.8 \ eV$) peak to the $25.6 \ nm$ ($48.3 \ eV$) was 10 compared to 5.4 for

helium alone as shown in Figure 1 which implies only a minor He II transition contribution to the 30.4 nm peak.

It is proposed that the majority of the 91.2 nm peak was also due to a novel transition. At 20 Torr, the ratio of the Lyman β peak to the 91.2 nm peak of the helium-hydrogen plasma was 2 compared to 8 for each control hydrogen and xenon-hydrogen plasma which indicates that the majority of the 91.2 nm peak was due to a transition other than the binding of an electron by a proton.

The novel peaks fit two empirical relationships. In order of energy, the set comprising the peaks at 91.2 nm, 45.6 nm, 30.4 nm, 13.03 nm, 10.13 nm, and 8.29 nm correspond to energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,7,9,11$. In order of energy, the set comprising the peaks at 37.4 nm, 20.5 nm, and 14.15 nm correspond to energies of $q \cdot 13.6 - 21.21\ eV$ where $q = 4,6,8$. These lines can be explained as electronic transitions to fractional Rydberg states of atomic hydrogen given by Eqs. (2a) and (2c) wherein the catalytic system involves helium ions because the second ionization energy of helium is $54.417\ eV$, which is equivalent to $2 \cdot 27.2\ eV$. In this case, $54.417\ eV$ is transferred nonradiatively from atomic hydrogen to He^+ which is resonantly ionized. The electron decays to the $n = 1/3$ state with the further release of $54.417\ eV$ which may be emitted as a photon. The catalysis reaction is
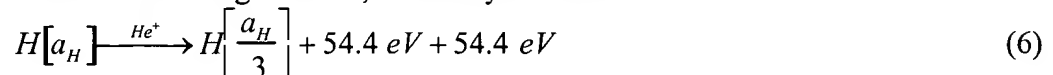
$$54.417\ eV + He^+ + H[a_H] \rightarrow He^{2+} + e^- + H\left[\frac{a_H}{3}\right] + 108.8\ eV \tag{3}$$

$$He^{2+} + e^- \rightarrow He^+ + 54.417\ eV \tag{4}$$

And, the overall reaction is

$$H[a_H] \rightarrow H\left[\frac{a_H}{3}\right] + 54.4\ eV + 54.4\ eV \tag{5}$$

Since the products of the catalysis reaction have binding energies of $m \cdot 27.2\ eV$, they may further serve as catalysts. Thus, further catalytic transitions may occur: $n = \frac{1}{3} \rightarrow \frac{1}{4}, \frac{1}{4} \rightarrow \frac{1}{5}$, and so on.

Electronic transitions to Rydberg states given by Eqs. (2a) and (2c) catalyzed by the resonant nonradiative transfer of $m \cdot 27.2\ eV$ would give rise to a series of emission lines of energies $q \cdot 13.6\ eV$ where q is an integer. It is further proposed that the photons that arise from hydrogen transitions may undergo inelastic helium scattering. That is, the catalytic reaction

$$H[a_H] \xrightarrow{He^+} H\left[\frac{a_H}{3}\right] + 54.4\ eV + 54.4\ eV \tag{6}$$

yields $54.4\ eV$ by Eq. (4) and a photon of $54.4\ eV$ ($22.8\ nm$). Once emitted, the photon may be absorbed or scattered. When this photon strikes $He\,(1s^2)$, $21.2\ eV$ may be absorbed in the excitation to $He\,(1s^1 2p^1)$. This leaves a $33.19\ eV$ ($37.4\ nm$) photon peak and a $21.2\ eV$ ($58.4\ nm$) photon from

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$He\,(1s^1 2p^1)$. Thus, for helium the inelastic scattered peak of 54.4 eV photons from Eq. (3) is given by

$$E = 54.4\,eV - 21.21\,eV = 33.19\,eV\ (37.4\ nm) \tag{7}$$

A novel peak shown in Figures 1 and 2 was observed at 37.4 nm. Furthermore, the intensity of the 58.4 nm peak corresponding to the spectra shown in Figure 2 was about 60,000 photons/sec. Thus, the transition $He\,(1s^2) \rightarrow He\,(1s^1 2p^1)$ dominated the inelastic scattering of EUV peaks. The general reaction is

$$photon\ (h\nu) + He\,(1s^2) \rightarrow He\,(1s^1 2p^1) + photon\ (h\nu - 21.21\ eV) \tag{8}$$

The two empirical series may be combined—one directly from Eqs. (2a, 2c) and the other indirectly with Eq. (8). The energies for the novel lines in order of energy are 13.6 eV, 27.2 eV, 40.8 eV, 54.4 eV, 81.6 eV, 95.2 eV, 108.8 eV, 122.4 eV and 149.6 eV. The corresponding peaks are 91.2 nm, 45.6 nm, 30.4 nm, 37.4 nm, 20.5 nm, 13.03 nm, 14.15 nm, 10.13 nm, and 8.29 nm, respectively. Thus, the identified novel lines correspond to energies of $q \cdot 13.6\,eV$ where $q = 1,2,3,4,6,7,8,9,11$ or these lines inelastically scattered by helium atoms wherein 21.2 eV was absorbed in the excitation of $He\,(1s^2)$ to $He\,(1s^1 2p^1)$. The values of q observed are consistent with those excepted based on Eq. (5) and the subsequent autocatalyzed reactions as discussed previously [6]. The satellite peak at 44.2 nm show in Figure 1 and 2 may be due to multipole coupling as discussed elsewhere [12]. There is remarkable agreement between the data and the proposed transitions to fractional Rydberg states and these lines inelastically scattered by helium according to Eq. (8). All other peaks could be assigned to He I, He II, second order lines, or atomic or molecular hydrogen emission. No known lines of helium or hydrogen explain the $q \cdot 13.6\,eV$ related set of peaks.

The Secret Committee refuses to consider Applicant's data of lower-energy hydrogen transitions is based on the false premise that it violates quantum theory. More importantly, Applicant's theory does not violate physical laws, such as Maxwell's equation, with which the Secret Committee's cited theory is in conflict. The fallacies of the Secret Committee's argument were pointed out in this Response. [See, in particular, Sections 3, 9, and 17] THEORY MUST CONFORM TO DATA RATHER THAN DATA CONFORM TO THEORY AS ESPOUSED BY THE SECRET COMMITTEE. THE SECRET COMMITTEE HAS SHOWN A CLEAR BIAS IN ITS DEFENSE OF QUANTUM MECHANICS, BUT IT CAN NOT MAKE APPLICANT'S DATA GO AWAY JUST BECAUSE IT WISHES IT SO. APPLICANT HAS MET THE BURDEN OF SHOWING THE SPECTRAL LINES THE SECRET COMMITTEE WAS LOOKING FOR. THE SECRET COMMITTEE HAS OFFERED NO OTHER

EXPLANATION OF THE LINES. APPLICANT HAS A RIGHT TO HAVE HIS APPLICATION FAIRLY EVALUATED—NOT DISMISSED OUT OF HAND.

The stability of the hydrino states was given in Section 7 of this Response.

The excited state lines of hydrogen are shown in Applicant's publications.[235] The hydrino transitions are also observed when a catalyst (in this case) is provided.[236] In the case of the spectrum of Bethe and Salpeter, no catalyst was present. Thus, no hydrino lines are predicted by Applicant. None were observed in agreement with Applicant's theory. As pointed out in previous sections of this Response such as Section 17, standard quantum mechanics can not possibility be the absolute representation of the hydrogen atom from which absolute conclusions about the existence or nonexistence of hydrinos can be drawn.

The Secret Committee has it exactly backwards. Applicant's spectral lines disprove quantum mechanics. Applicant's theory is based on Maxwell's equations which is a physical law. See Sections I, 2, 3, 7, 14, and 17 of this Response. The Secret Committee argues that a fatally flawed internally inconsistent probability wave theory is the sole basis to reject the present invention. The Secret Committee is misguided and incorrect in its assessment that "Hence standard quantum mechanics is a thousand times more accurate in its predictive power, for the spectral lines of the hydrogen atom, compared to applicant's improper theory." Only Applicant's theory is derived from first principles and holds over a scale of spacetime of 85 orders of magnitude—it correctly predicts the nature of the universe from the scale of the quarks to that of the cosmos. Quantum mechanics and the Heisenberg Uncertainty Principle are not laws of nature. They are based on circular arguments that the electron is a probability wave requiring that the electron have multiple positions and energies including negative and infinite energies simultaneously. Both are postulated, cannot be proven experimentally, and predict consequences such as violation of conservation of energy and momentum and an essentially infinite

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[235] Reference 21.

[236] Reference 21.

cosmological constant. These predictions are not in agreement with experimentation. Furthermore, it was recently proven experimentally that the Heisenberg Uncertainty principle has nothing to do with wave-particle duality;[237] whereas, the opposite is largely touted as one of its triumphs. In contrast, the observable features of atomic particles such as the electron g factor may be calculated in closed form from Maxwell's equations with 11-figure accuracy without invoking the vagaries and inconsistencies inherent with the Heisenberg Uncertainty Principle.[238] And, Applicant's predicts fractions as "allowed" in the Rydberg energy equation. These states are demonstrated experimentally. The Secret Committee can not dismiss the data just because it wishes to do so. The Secret Committee has offered no explanation for the data summarized in Section I of this Response.

The independent work performed at Institut fur Niedertemperatur-Plasmaphysik e.V. was supported by Applicant. However, to suggest that the Director and Chairman of the Board of one Germany's most prestigious National Laboratories, once headed by two Noble Laureates Stark and Mie, would compromise his scientific integrity is unreasonable.

Since all of SCIENCE AS WELL AS THE PATENT OFFICE IS PAID FOR BY OUTSIDE SOURCES, then by the Secret Committees argument, all of science and the Patent Office ARE SUSPECT.

Both papers of the declaration have gone through extensive peer review and have been made even more compelling. They are scheduled to appears as new journal articles:

R. Mills, P. Ray, "Spectroscopic Identification of a Novel Catalytic Reaction of Potassium and Atomic Hydrogen and the Hydride Ion Product", Int. J. Hydrogen Energy, Vol. 27, No. 2, (2002), pp. 183-192.

R. Mills, P. Ray, "Spectral Emission of Fractional Quantum Energy Levels of

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[237] References 32 and 45.

[238] Reference 39.

Atomic Hydrogen from a Helium-Hydrogen Plasma and the Implications for Dark Matter", Int. J. Hydrogen Energy, Vol. 27, No. 3, (2002), pp. 301-322.

In addition, Applicant has obtained overwhelming spectroscopic data of the existence of lower-energy hydrogen which matches theoretical predictions remarkably well. For example, on page 4, lines 8-12 of the present specification, Applicant discloses:

The hydride ion of the present invention is formed by the reaction of an electron with a hydrogen atom having a binding energy given by

$$Binding\ Energy = \frac{13.6\ eV}{n^2} \tag{2}$$

where $n = \dfrac{1}{p}$ and p is an integer greater than one.

From R. L. Mills, P. Ray, B. Dhandapani, J. He, "Spectroscopic Identification of Fractional Rydberg States of Atomic Hydrogen", J. of Phys. Chem. (letter), submitted:

Extreme ultraviolet (EUV) spectroscopy was recorded on microwave discharges of helium with 2% hydrogen. Novel emission lines were observed with energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,4,6,7,8,9,11,12$ or these lines inelastically scattered by helium atoms wherein 21.2 eV was absorbed in the excitation of $He\,(1s^2)$ to $He\,(1s^1 2p^1)$. These lines can be explained as fractional Rydberg states of atomic hydrogen. Novel emission lines were also observed at 44.2 nm and 40.5 nm with energies of $q \cdot 13.6 + \left(\dfrac{1}{n_f^2} - \dfrac{1}{n_i^2} \right) X 13.6\ eV$ where $q = 2$ and $n_f = 2,4$ $n_i = \infty$ that corresponded to multipole coupling to give two photon emission from a continuum excited state atom and an atom undergoing a fractional Rydberg state transition. Such transitions would be extremely energetic; so, the width of the 656.2 nm Balmer α line emitted from the plasmas was measured, and the electron temperature T_e was measured from the ratio of the intensity of the He 501.6 nm line to that of the He 492.2 line. Significant line broadening corresponding to an average hydrogen atom temperature of 180 - 210 eV was observed for helium-hydrogen microwave plasmas; whereas, pure hydrogen showed no excessive broadening corresponding to an average hydrogen atom temperature of $\approx 3\ eV$. Similarly, the average electron temperature for helium-hydrogen plasma was 28,000 K; whereas, the corresponding temperature of helium alone was only 6800 K.

THE SECRET COMMITTEE OFFERS NO EXPLANATION FOR THIS DATA OF LOWER ENERGY ATOMIC HYDROGEN EMISSION—MERELY DISMISSES IT BASED ON A FLAWED THEORY.

From page 3, line 30 through page 4, line 19 of the present specification, Applicant discloses:

SUMMARY OF THE INVENTION

This invention is directed to a new composition of matter comprising a hydride ion (H^-) having a binding energy greater than $0.8\ eV$, as reflected in the following formula

$$Binding\ Energy = \frac{\hbar^2\sqrt{s(s+1)}}{8\mu_e a_0^2\left[\frac{1+\sqrt{s(s+1)}}{p}\right]^2} - \frac{\pi\mu_0 e^2\hbar^2}{m_e^2 a_0^3}\left(1+\frac{2^2}{\left[\frac{1+\sqrt{s(s+1)}}{p}\right]^3}\right) \tag{1}$$

where p is an integer greater than one, $s=1/2$, π is pi, $\hbar$ is Planck's constant bar, μ_o is the permeability of vacuum, m_e is the mass of the electron, μ_e is the reduced electron mass, a_o is the Bohr radius, and e is the elementary charge. An ion comprising an ordinary hydrogen nucleus and two electrons having the binding energy of 0.8 eV is hereinafter referred to as "ordinary hydride ion." The hydride ion comprises two indistinguishable electrons bound to a proton. The hydride ion of the present invention is formed by the reaction of an electron with a hydrogen atom having a binding energy given by

$$Binding\ Energy = \frac{13.6\ eV}{n^2} \tag{2}$$

where $n=\frac{1}{p}$ and p is an integer greater than one. (The binding energy is the energy required to remove an electron from an atom or a molecule and is equivalent to the ionization energy.) A hydrogen atom having the binding energy given in Eq. (2) is hereafter referred to as a <u>hydrino atom or hydrino</u>. The designation for a hydrino of radius $\frac{a_H}{p}$, where a_H is the radius of an ordinary hydrogen atom and p is an integer, is $H\left[\frac{a_H}{p}\right]$. A hydrogen atom with a radius a_H is hereinafter referred to as "ordinary hydrogen atom."
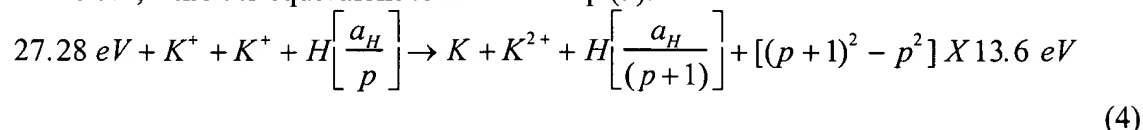
Hydrinos are formed by reacting an ordinary hydrogen atom with a catalyst having a net enthalpy of reaction of about
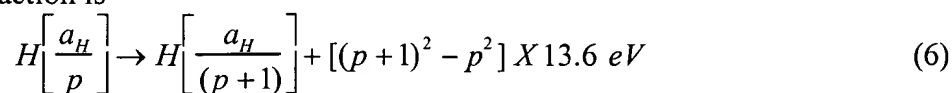
$$m\cdot 27.21\ eV \tag{3}$$

where m is an integer.

This catalysis releases energy with a commensurate decrease in size of the hydrogen atom, $r_n = na_H$. For example, the catalysis of $H(n=1)$ to $H(n=1/2)$

releases $40.8\ eV$, and the hydrogen radius decreases from a_H to $\frac{1}{2}a_H$. One such catalytic system involves potassium. The second ionization energy of potassium is $31.63\ eV$; and K^+ releases $4.34\ eV$ when it is reduced to K. The combination of reactions K^+ to K^{2+} and K^+ to K, then, has a net enthalpy of reaction of $27.28\ eV$, which is equivalent to $m=1$ in Eq. (3).

$$27.28\ eV + K^+ + K^+ + H\left[\frac{a_H}{p}\right] \rightarrow K + K^{2+} + H\left[\frac{a_H}{(p+1)}\right] + [(p+1)^2 - p^2]\,X\,13.6\ eV$$

(4)

$$K + K^{2+} \rightarrow K^+ + K^+ + 27.28\ eV$$

(5)

The overall reaction is

$$H\left[\frac{a_H}{p}\right] \rightarrow H\left[\frac{a_H}{(p+1)}\right] + [(p+1)^2 - p^2]\,X\,13.6\ eV$$

(6)

Note that the energy given off during catalysis is much greater than the energy lost to the catalyst. The energy released is large as compared to conventional chemical reactions. For example, when hydrogen and oxygen gases undergo combustion to form water

$$H_2\,(g) + \frac{1}{2}O_2\,(g) \rightarrow H_2O\,(l)$$

(7)

the known enthalpy of formation of water is $\Delta H_f = -286\ kJ\,/\,mole$ or 1.48 eV per hydrogen atom. By contrast, each ($n=1$) ordinary hydrogen atom undergoing catalysis releases a net of $40.8\ eV$. Moreover, further catalytic transitions may occur: $n = \frac{1}{2} \rightarrow \frac{1}{3},\ \frac{1}{3} \rightarrow \frac{1}{4},\ \frac{1}{4} \rightarrow \frac{1}{5}$, and so on. Once catalysis begins, hydrinos autocatalyze further in a process called disproportionation. This mechanism is similar to that of an inorganic ion catalysis. But, hydrino catalysis should have a higher reaction rate than that of the inorganic ion catalyst due to the better match of the enthalpy to $m \cdot 27.2\ eV$.

From R. L. Mills, P. Ray, " High Resolution Spectroscopic Observation of the Bound-Free Hyperfine Levels of a Novel Hydride Ion Corresponding to a Fractional Rydberg State of Atomic Hydrogen", Int. J. Hydrogen Energy, in press:

From a solution of a Schrodinger-type wave equation with a nonradiative boundary condition based on Maxwell's equations, Mills solves the hydrogen atom, the hydride ion, and predicts corresponding species having fractional principal quantum numbers. Atomic hydrogen may undergo a catalytic reaction with certain atomized elements and ions which singly or multiply ionize at integer multiples of the potential energy of atomic hydrogen, $m \cdot 27.2\ eV$ wherein m is an integer. The reaction involves a nonradiative energy transfer to form a hydrogen atom $H(1/p)$ that is lower in energy than unreacted atomic hydrogen that

corresponds to a fractional principal quantum number ($n = \dfrac{1}{p} = \dfrac{1}{\text{integer}}$ replaces the well known parameter $n =$ integer in the Rydberg equation for hydrogen excited states). The ionization of Rb^{+} and an electron transfer between two K^{+} ions (K^{+}/K^{+}) provide a reaction with a net enthalpy of 27.2 eV which serve as catalysts of atomic hydrogen to form $H(1/2)$. Intense extreme ultraviolet (EUV) emission was observed from incandescently heated atomic hydrogen and each of atomized potassium and rubidium ions that generated a plasma called a resonance transfer or rt-plasma at low temperatures (e.g. $\approx 10^{3}\ K$) and an extraordinary low field strength of about 1-2 V/cm. For further characterization, the width of the 6562 Å Balmer α line was recorded. Significant line broadening of 17 and 9 eV was observed from a rt-plasma of hydrogen with K^{+}/K^{+} and Rb^{+} respectively. These results could not be explained by Stark or thermal broadening or electric field acceleration of charged species since the measured field of the incandescent heater was extremely weak, 1 V/cm, corresponding to a broadening of much less than 1 eV. Rather the source of the excessive line broadening is consistent with that of the observed EUV emission, an energetic reaction caused by a resonance energy transfer between hydrogen atoms and K^{+}/K^{+} or Rb^{+}. The catalyst product $H(1/2)$ was predicted to be a highly reactive intermediate which further reacts to form a novel hydride ion $H^{-}(1/2)$. This hydride ion with a predicted binding energy of 3.0468 eV was observed by high resolution visible spectroscopy as a broad peak at 4070.0 Å with a FWHM of 1.4 Å. From the electron g factor, bound-free hyperfine structure lines of $H^{-}(1/2)$ were predicted with energies E_{HF} given by $E_{HF} = j^{2}3.0056 X 10^{-5} + 3.0575\ eV$ (j is an integer) as an inverse Rydberg-type series that converges at increasing wavelengths and terminates at 3.0575 eV—the hydride spin-pairing energy plus the binding energy. The high resolution visible plasma emission spectra in the region of 4000 Å to 4060 Å matched the predicted emission lines for $j = 1$ to $j = 37$ to 1 part in 10^{5}.

THE SECRET COMMITTEE OFFERS NO EXPLANATION FOR THIS DATA OF LOWER ENERGY HYDRIDE ION EMISSION AND EXTRAORDINARY PLASMA FORMATION GIVEN THE CONDITIONS—MERELY DISMISSES IT BASED ON A FLAWED THEORY.

From page 41, line 24 through page 43, line 23 of the present specification, Applicant discloses:

DIHYDRINO METHODS

The theoretical introduction to dihydrinos is provided in the '96 Mills

GUT. Two hydrino atoms $H\left[\dfrac{a_H}{p}\right]$ may react to form a diatomic molecule referred to as a dihydrino $H_2^*\left[2c' = \dfrac{\sqrt{2}\,a_o}{p}\right]$.

$$2H\left[\frac{a_H}{p}\right] \to H_2^*\left[2c' = \frac{\sqrt{2}\,a_o}{p}\right] \tag{23}$$

where p is an integer. The dihydrino comprises a hydrogen molecule having a total energy, $E_T\left(H_2^*\left[2c' = \dfrac{\sqrt{2}\,a_0}{p}\right]\right)$,

$$E_T\left(H_2^*\left[2c' = \frac{\sqrt{2}\,a_0}{p}\right]\right) = -13.6\ eV\left[\left(2p^2\sqrt{2} - p^2\sqrt{2} + \frac{p^2\sqrt{2}}{2}\right)\ln\frac{\sqrt{2}+1}{\sqrt{2}-1} - p^2\sqrt{2}\right] \tag{24}$$

where $2c'$ is the internuclear distance and a_o is the Bohr radius. Thus, the relative internuclear distances (sizes) of dihydrinos are fractional. Without considering the correction due to zero order vibration, the bond dissociation energy, $E_D\left(H_2^*\left[2c' = \dfrac{\sqrt{2}\,a_0}{p}\right]\right)$, is given by the difference between the energy of two hydrino atoms each given by the negative of Eq. (2) and the total energy of the dihydrino molecule given by Eq. (24). (The bond dissociation energy is defined as the energy required to break the bond).

$$E_T\left(H_2^*\left[2c' = \frac{2a_o}{p}\right]^+\right) = 13.6\ eV(-4p^2\ln 3 + p^2 + 2p^2\ln 3) \tag{26}$$

The first binding energy, BE_1, of the dihydrino molecular ion with consideration of zero order vibration is about

$$BE_1 = \frac{16.4}{\left(\frac{1}{p}\right)^2}\ eV \tag{26a}$$

Without considering the correction due to zero order vibration, the bond dissociation energy, $E_D\left(H_2^*\left[2c' = \dfrac{2a_o}{p}\right]^+\right)$, is the difference between the negative of the binding energy of the corresponding hydrino atom given by Eq. (2) and $E_T\left(H_2^*\left[2c' = \dfrac{2a_o}{p}\right]^+\right)$ given by Eq. (26).

$$E_D\left(H_2^*\left[2c' = \frac{2a_o}{p}\right]^+\right) = E\left(H\left[\frac{a_H}{p}\right]\right) - E_T\left(H_2^*\left[2c' = \frac{2a_o}{p}\right]^+\right) \tag{27}$$

The first binding energy, BE_1, of the dihydrino molecule

$$H_2^*\left[2c' = \frac{\sqrt{2}a_o}{p}\right] \rightarrow H_2^*\left[2c' = \frac{2a_o}{p}\right]^+ + e^- \tag{28}$$
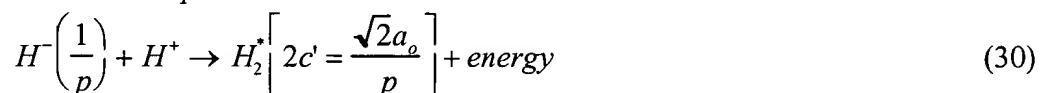
is given by Eq. (26) minus Eq. (24).

$$BE_1 = E_T\left(H_2^*\left[2c' = \frac{2a_o}{p}\right]^+\right) - E_T\left(H_2^*\left[2c' = \frac{\sqrt{2}a_o}{p}\right]\right) \tag{29}$$

The second binding energy, BE_2, is given by the negative of Eq. (26). The first binding energy, BE_1, of the dihydrino molecule with consideration of zero order vibration is about
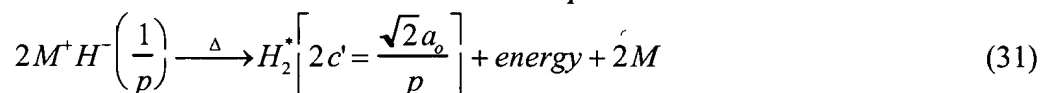
$$BE_1 = \frac{15.5}{\left(\frac{1}{p}\right)^2} \ eV \tag{29a}$$

The dihydrino and the dihydrino ion are further described in the '96 Mills GUT, and PCT/US96/07949 and PCT/US/94/02219.

A method to prepare dihydrino gas from the hydrino hydride comprises reacting hydrino hydride with a source of protons including acid, protons of a plasma of a gas discharge cell, and protons from a metal hydride. The reaction of hydrino hydride $H^-\left(\frac{1}{p}\right)$ with a proton is

$$H^-\left(\frac{1}{p}\right) + H^+ \rightarrow H_2^*\left[2c' = \frac{\sqrt{2}a_o}{p}\right] + energy \tag{30}$$
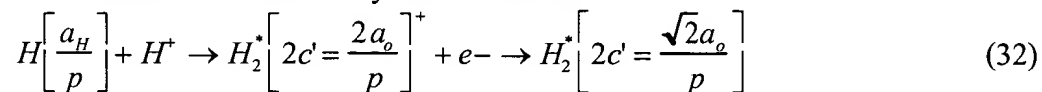
One way to make dihydrino gas from hydrino hydride is by thermally decomposing the hydride. For example, potassium hydrino hydride is heated until potassium metal is formed together with dihydrino gas. An example of a thermal decomposition reaction of hydrino hydride $M^+H^-\left(\frac{1}{p}\right)$ is

$$2M^+H^-\left(\frac{1}{p}\right) \xrightarrow{\Delta} H_2^*\left[2c' = \frac{\sqrt{2}a_o}{p}\right] + energy + 2M \tag{31}$$

where M^+ is the cation.

A hydrino can react with a proton to form a dihydrino ion which further reacts with an electron to form a dihydrino molecule.

$$H\left[\frac{a_H}{p}\right] + H^+ \rightarrow H_2^*\left[2c' = \frac{2a_o}{p}\right]^+ + e- \rightarrow H_2^*\left[2c' = \frac{\sqrt{2}a_o}{p}\right] \tag{32}$$

The energy of the reaction of the hydrino atom with a proton is given by the negative of the bond energy of the dihydrino ion (Eq. (27)). The energy given by the reduction of the dihydrino ion by an electron is the negative of the first binding energy (Eq. (29)). These reactions emit UV radiation. UV spectroscopy is a way to study the emitted radiation.

From R. Mills, P. Ray, "Vibrational Spectral Emission of Fractional-Principal-Quantum-Energy-Level Hydrogen Molecular Ion", Int. J. Hydrogen Energy, in press:

From a solution of a Schrodinger-type wave equation with a nonradiative boundary condition based on Maxwell's equations, Mills solves the hydrogen atom, the hydrogen molecular ion, the hydrogen molecule and predicts corresponding species having fractional principal quantum numbers. Atomic hydrogen may undergo a catalytic reaction with certain atomized elements and ions which singly or multiply ionize at integer multiples of the potential energy of atomic hydrogen, $m \cdot 27.2 \ eV$ wherein m is an integer. The reaction involves a nonradiative energy transfer to form a hydrogen atom $H(1/p)$ that is lower in energy than unreacted atomic hydrogen that corresponds to a fractional principal quantum number ($n = \dfrac{1}{p} = \dfrac{1}{integer}$ replaces the well known parameter n = integer in the Rydberg equation for hydrogen excited states). One such atomic catalytic system involves argon ions. The reaction Ar^+ to Ar^{2+} has a net enthalpy of reaction of $27.63 \ eV$, which is equivalent to $m = 1$. Thus, it may serve as a catalyst to form $H(1/2)$. Also, the second ionization energy of helium is $54.4 \ eV$; thus, the ionization reaction of He^+ to He^{2+} has a net enthalpy of reaction of $54.4 \ eV$ which is equivalent to $2 \cdot 27.2 \ eV$. The products of the catalysis reaction $H(1/3)$ may further serve as catalysts to form $H(1/4)$ and $H(1/2)$. $H(1/p)$ may react with a proton to form an excited state molecular ion $H_2^*(1/p)^+$ that has a bond energy and vibrational levels that are p^2 times those of the molecular ion comprising uncatalyzed atomic hydrogen where p is an integer. Thus, the excited state spectrum of $H_2^*[n = 1/4; n^* = 2]^+$ was predicted to comprise rotationally broadened vibrational transitions at 1.185 eV increments to the dissociation limit of $H_2[n = 1/4]^+$, $E_D = 42.88 \ eV \ (28.92 \ nm)$. Extreme ultraviolet (EUV) spectroscopy was recorded on microwave discharges of argon or helium with 10% hydrogen in the range $10 - 65 \ nm$. Novel emission lines assigned to vibrational transitions of $H_2^*[n = 1/4; n^* = 2]^+$ were observed in this range with energies of $\upsilon \cdot 1.185 \ eV$, $\upsilon = 17 \ to \ 38$ that terminated at about $28.9 \ nm$. In addition, fractional molecular hydrogen rotational transitions were assigned to previously unidentified lines in the Solar coronal spectrum that matched theoretical predictions to five figures.

THE SECRET COMMITTEE OFFERS NO RELATED EXPLANATION WHICH COULD CHALLENGE THIS NEWLY SUBMITTED DATA OF LOWER ENERGY HYDROGEN MOLECULAR ION EMISSION—MERELY DISMISSES IT BASED ON A FLAWED

THEORY.

From page 3, line 30 through page 11, line 13 of the present specification, Applicant discloses:

SUMMARY OF THE INVENTION

This invention is directed to a new composition of matter comprising a hydride ion (H^-) having a binding energy greater than $0.8\ eV$, as reflected in the following formula

$$Binding\ Energy = \frac{\hbar^2 \sqrt{s(s+1)}}{8\mu_e a_0^2 \left[\frac{1+\sqrt{s(s+1)}}{p}\right]^2} - \frac{\pi\mu_0 e^2 \hbar^2}{m_e^2 a_0^3}\left(1+\frac{2^2}{\left[\frac{1+\sqrt{s(s+1)}}{p}\right]^3}\right) \tag{1}$$

where p is an integer greater than one, $s = 1/2$, π is pi, $\hbar$ is Planck's constant bar, μ_0 is the permeability of vacuum, m_e is the mass of the electron, μ_e is the reduced electron mass, a_0 is the Bohr radius, and e is the elementary charge. An ion comprising an ordinary hydrogen nucleus and two electrons having the binding energy of 0.8 eV is hereinafter referred to as "ordinary hydride ion." The hydride ion comprises two indistinguishable electrons bound to a proton. The hydride ion of the present invention is formed by the reaction of an electron with a hydrogen atom having a binding energy given by

$$Binding\ Energy = \frac{13.6\ eV}{n^2} \tag{2}$$

where $n = \frac{1}{p}$ and p is an integer greater than one. (The binding energy is the energy required to remove an electron from an atom or a molecule and is equivalent to the ionization energy.) A hydrogen atom having the binding energy given in Eq. (2) is hereafter referred to as a <u>hydrino atom or hydrino</u>. The designation for a hydrino of radius $\frac{a_H}{p}$, where a_H is the radius of an ordinary hydrogen atom and p is an integer, is $H\left[\frac{a_H}{p}\right]$. A hydrogen atom with a radius a_H is hereinafter referred to as "ordinary hydrogen atom."
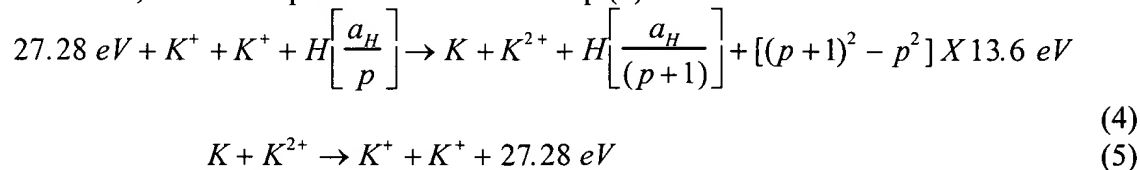
Hydrinos are formed by reacting an ordinary hydrogen atom with a catalyst having a net enthalpy of reaction of about
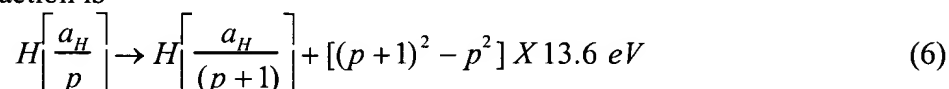
$$m \cdot 27.21\ eV \tag{3}$$

where m is an integer.

This catalysis releases energy with a commensurate decrease in size of the hydrogen atom, $r_n = na_H$. For example, the catalysis of $H(n = 1)$ to $H(n = 1/2)$ releases $40.8\ eV$, and the hydrogen radius decreases from a_H to $\frac{1}{2}a_H$. One such catalytic system involves potassium. The second ionization energy of potassium is $31.63\ eV$; and K^+ releases $4.34\ eV$ when it is reduced to K. The combination of reactions K^+ to K^{2+} and K^+ to K, then, has a net enthalpy of reaction of $27.28\ eV$, which is equivalent to $m = 1$ in Eq. (3).

$$27.28\ eV + K^+ + K^+ + H\left[\frac{a_H}{p}\right] \to K + K^{2+} + H\left[\frac{a_H}{(p+1)}\right] + [(p+1)^2 - p^2]\, X\, 13.6\ eV$$

(4)

$$K + K^{2+} \to K^+ + K^+ + 27.28\ eV \tag{5}$$

The overall reaction is

$$H\left[\frac{a_H}{p}\right] \to H\left[\frac{a_H}{(p+1)}\right] + [(p+1)^2 - p^2]\, X\, 13.6\ eV \tag{6}$$
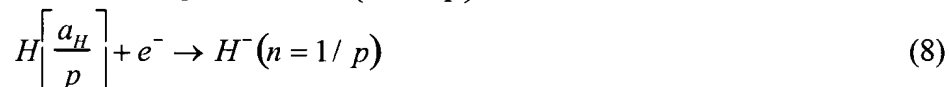
Note that the energy given off during catalysis is much greater than the energy lost to the catalyst. The energy released is large as compared to conventional chemical reactions. For example, when hydrogen and oxygen gases undergo combustion to form water

$$H_2\ (g) + \frac{1}{2}O_2\ (g) \to H_2O\ (l) \tag{7}$$

the known enthalpy of formation of water is $\Delta H_f = -286\ kJ\,/\,mole$ or 1.48 eV per hydrogen atom. By contrast, each $(n = 1)$ ordinary hydrogen atom undergoing catalysis releases a net of $40.8\ eV$. Moreover, further catalytic transitions may occur: $n = \frac{1}{2} \to \frac{1}{3},\ \frac{1}{3} \to \frac{1}{4},\ \frac{1}{4} \to \frac{1}{5}$, and so on. Once catalysis begins, hydrinos autocatalyze further in a process called <u>disproportionation</u>. This mechanism is similar to that of an inorganic ion catalysis. But, hydrino catalysis should have a higher reaction rate than that of the inorganic ion catalyst due to the better match of the enthalpy to $m \cdot 27.2\ eV$.

Hydrino $H\left[\frac{a_H}{p}\right]$ reacts with an electron to form a corresponding <u>hydrino hydride ion</u>, hereinafter designated as $H^-\left(n = 1/p\right)$:

$$H\left[\frac{a_H}{p}\right] + e^- \to H^-\left(n = 1/p\right) \tag{8}$$

The binding energies of the hydrino hydride ion $H^-\left(n = 1/p\right)$ as a function of p, where p is an integer, are shown in TABLE 1.

TABLE 1. The representative binding energy of the hydrino hydride ion $H^-(n = 1/p)$ as a function of p, Eq. (1).

Hydride Ion	r_1 $(a_o)^a$	Binding Energy^b (eV)	Wavelength (nm)
$H^-(n = 1/2)$	0.9330	3.047	407
$H^-(n = 1/3)$	0.6220	6.610	188
$H^-(n = 1/4)$	0.4665	11.23	110
$H^-(n = 1/5)$	0.3732	16.70	74.2
$H^-(n = 1/6)$	0.3110	22.81	54.4
$H^-(n = 1/7)$	0.2666	29.34	42.3
$H^-(n = 1/8)$	0.2333	36.08	34.4
$H^-(n = 1/9)$	0.2073	42.83	28.9
$H^-(n = 1/10)$	0.1866	49.37	25.1
$H^-(n = 1/11)$	0.1696	55.49	22.3
$H^-(n = 1/12)$	0.1555	60.97	20.3
$H^-(n = 1/13)$	0.1435	65.62	18.9
$H^-(n = 1/14)$	0.1333	69.21	17.9
$H^-(n = 1/15)$	0.1244	71.53	17.3
$H^-(n = 1/16)$	0.1166	72.38	17.1

[a] Equation (21)

[b] Equation (22)

According to the present invention, a hydride ion (H^-) is provided having a binding energy greater than 0.8 eV. The binding energy, also known as the ionization energy, of an atom, ion or molecule is the energy required to remove one electron from the atom, ion or molecule. Hydride ions having a binding of about 3, 7, 11, 17, 23, 29, 36, 43, 49, 55, 61, 66, 69, 71 and 72 eV are provided.

According to another embodiment of the invention, a compound is provided, comprising at least one increased binding energy hydrogen species. The increased binding energy hydrogen species is selected from the group consisting of (a) increased binding energy hydride ions having a binding energy greater than 0.8 eV, (b) increased binding energy hydrogen atoms having a binding energy of about $13.6/n^2$ eV, (c) increased binding energy hydrogen molecules having a first

binding energy of about $15.5/n^2$ eV, and (d) increased binding energy molecular hydrogen ion having a binding energy of about $16.4/n^2$ eV. The variable "n" is a fraction whose numerator is 1 and denominator is an integer greater than 1.

The compound is preferably greater than 50 atomic percent pure. More preferably, the compound is greater than 90 atomic percent pure. Most preferably, the compound is greater than 98 atomic percent pure.

The compound may further comprise one or more cations, such as a proton or H_3^+.

The compound may further comprise one or more normal hydrogen atoms and/or normal hydrogen molecules.

The compound may have the formula MH, MH_2, or M_2H_2, wherein M is an alkali cation and H is an increased binding energy hydride ion or an increased binding energy hydrogen atom.   The compound may have the formula MH_n wherein n is 1 or 2, M is an alkaline earth cation and H is an increased binding energy hydride ion or an increased binding energy hydrogen atom.

The compound may have the formula MHX wherein M is an alkali cation, X is one of a neutral atom, a molecule, or a singly negatively charged anion, and H is an increased binding energy hydride ion or an increased binding energy hydrogen atom.

The compound may have the formula MHX wherein M is an alkaline earth cation, X is a singly negatively charged anion, and H is an increased binding energy hydride ion or an increased binding energy hydrogen atom.

The compound may have the formula MHX wherein M is an alkaline earth cation, X is a doubly negatively charged anion, and H is an increased binding energy hydrogen atom.

The compound may have the formula M_2HX wherein M is an alkali cation, X is a singly negatively charged anion, and H is an increased binding energy hydride ion or an increased binding energy hydrogen atom.

The compound may have the formula MH_n wherein n is an integer from 1 to 5, M is an alkaline cation and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula M_2H_n wherein n is an integer from 1 to 4, M is an alkaline earth cation and the hydrogen content H_n of the compound

comprises at least one increased binding energy hydrogen species.

The compound may have the formula M_2XH_n wherein n is an integer from 1 to 3, M is an alkaline earth cation, X is a singly negatively charged anion, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula $M_2X_2H_n$ wherein n is 1 or 2, M is an alkaline earth cation, X is a singly negatively charged anion, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula M_2X_3H wherein M is an alkaline earth cation, X is a singly negatively charged anion, and H is an increased binding energy hydride ion or an increased binding energy hydrogen atom.

The compound may have the formula M_2XH_n wherein n is 1 or 2, M is an alkaline earth cation, X is a doubly negatively charged anion, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula $M_2XX'H$ wherein M is an alkaline earth cation, X is a singly negatively charged anion, X' is a doubly negatively charged anion, and H is an increased binding energy hydride ion or an increased binding energy hydrogen atom.

The compound may have the formula $MM'H_n$ wherein n is an integer from 1 to 3, M is an alkaline earth cation, M' is an alkali metal cation and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula $MM'XH_n$ wherein n is 1 or 2, M is an alkaline earth cation, M' is an alkali metal cation, X is a singly negatively charged anion and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula $MM'XH$ wherein M is an alkaline earth cation, M' is an alkali metal cation, X is a doubly negatively charged anion and H is an increased binding energy hydride ion or an increased binding energy hydrogen atom.

The compound may have the formula $MM'XX'H$ wherein M is an alkaline earth cation, M' is an alkali metal cation, X and X' are singly negatively charged

anion and H is an increased binding energy hydride ion or an increased binding energy hydrogen atom.

The compound may have the formula H_nS wherein n is 1 or 2 and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula $MSiH_n$ wherein n is an integer from 1 to 6, M is an alkali or alkaline earth cation, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula $MXX'H_n$ wherein n is an integer from 1 to 5, M is an alkali or alkaline earth cation, X is a singly or doubly negatively charged anion, X' is Si, Al, Ni, a transition element, an inner transition element, or a rare earth element, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula $MAlH_n$ wherein n is an integer from 1 to 6, M is an alkali or alkaline earth cation and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula MH_n wherein n is an integer from 1 to 6, M is a transition element, an inner transition element, a rare earth element, or Ni, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula $MNiH_n$ wherein n is an integer from 1 to 6, M is an alkali cation, alkaline earth cation, silicon, or aluminum, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula MXH_n wherein n is an integer from 1 to 6, M is an alkali cation, alkaline earth cation, silicon, or aluminum, X is a transition element, inner transition element, or a rare earth element cation, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula $MSiH_n$ wherein n is an integer from 1 to 8, M is an alkali or alkaline earth cation, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula Si_2H_n wherein n is an integer from 1

to 8, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula SiH_n wherein n is an integer from 1 to 8, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula TiH_n wherein n is an integer from 1 to 4, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula Al_2H_n wherein n is an integer from 1 to 4, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula $MXAlX'H_n$ wherein n is 1 or 2, M is an alkali or alkaline earth cation, X and X' are either a singly negatively charged anion or a doubly negatively charged anion, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula $MXSiX'H_n$ wherein n is 1 or 2, M is an alkali or alkaline earth cation, X and X' are either a singly negatively charged anion or a doubly negatively charged anion, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula SiO_2H_n wherein n is an integer from 1 to 6, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula $MSiO_2H_n$ wherein n is an integer from 1 to 6, M is an alkali or alkaline earth cation, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula MSi_2H_n wherein n is an integer from 1 to 6, M is an alkali or alkaline earth cation, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

The compound may have the formula M_2SiH_n wherein n is an integer from 1 to 8, M is an alkali or alkaline earth cation, and the hydrogen content H_n of the compound comprises at least one increased binding energy hydrogen species.

In MHX, M_2HX, M_2XH_n, $M_2X_2H_n$, M_2X_3H, $M_2XX'H$, $MM'XH_n$,

MM'XX'H, MXX'H$_n$, MXAlX'H$_n$, the singly negatively charged anion may be a halogen ion, hydroxide ion, hydrogen carbonate ion, or nitrate ion.

In MHX, M$_2$XH$_n$, M$_2$XX'H, MM'XH, MXX'H$_n$, MXAlX'H$_n$, the doubly negatively charged anion may be a carbonate ion or sulfate ion.

FROM R. MILLS, B. DHANDAPANI, M. NANSTEEL, J. HE, T. SHANNON, A. ECHEZURIA, "SYNTHESIS AND CHARACTERIZATION OF NOVEL HYDRIDE COMPOUNDS", INT. J. OF HYDROGEN ENERGY, VOL. 26, NO. 4, (2001), PP. 339-367:

Novel inorganic alkali and alkaline earth hydrides of the formula *MHX* and *MHMX* wherein *M* is the metal, *X*, is a singly negatively charged anion, and *H* comprises a novel high binding energy hydride ion were synthesized in a high temperature gas cell by reaction of atomic hydrogen with a catalyst and *MX* or *MX$_2$* corresponding to an alkali metal or alkaline earth metal, respectively. It has been reported that intense extreme ultraviolet (EUV) emission was observed at low temperatures (e.g. $\approx 10^3\ K$) from atomic hydrogen and certain atomized elements or certain gaseous ions which ionize at integer multiples of the potential energy of atomic hydrogen, 27.2 *eV* [1-6]. These atomized elements or certain gaseous ions comprised the catalyst to form *MHX* and *MHMX*. For example, atomic hydrogen was reacted with strontium vapor and *SrBr$_2$* to form *SrHBr*. Novel hydride compounds such as *SrHBr* were identified by time of flight secondary ion mass spectroscopy, X-ray photoelectron spectroscopy, proton nuclear magnetic resonance spectroscopy, and thermal decomposition with analysis by gas chromatography, and mass spectroscopy. Hydride ions with increased binding energies form novel compounds with potential broad applications such as a high voltage battery for consumer electronics and electric vehicles. In addition, these novel compositions of matter and associated technologies may have far-reaching applications in many industries including chemical, electronics, computer, military, energy, and aerospace in the form of products such as propellants, solid fuels, surface coatings, structural materials, and chemical processes.

THE SECRET COMMITTEE OFFERS NO EXPLANATION FOR THIS DATA OF NOVEL LOWER-ENERGY-HYDROGEN COMPOUNDS—MERELY DISMISSES IT BASED ON A FLAWED THEORY AND PRESENTS $\beta - $**Mg$_2NiH_4$** AS THE PRIOR ART FOR THE DISCLOSED **ALKALI AND ALKALINE EARTH HYDRIDES AND HALIDO HYDRIDES** (See Section 19 of this Response).

The data provided is spectroscopic data.[239] The spectra from state of the art instruments were provided for the Secret Committee. The Committee has presented no other explanation for the observed peaks. Only hydrogen and helium were present. Hydrogen has no peaks short of 78 nm, and the except for 30.4 nm none of the 13 peaks identified by Applicant that are correspond to helium. The Committee has not presented any plausible argument why any other laboratory would record a different spectrum than those provided by Applicant. For example, whether our commercial instrument records the spectrum of a helium plasma at BlackLight's facilitaty in Princeton or at any other laboratory in the world, the instrument would be expected to be the perform identically. The spectral data stands on its own, and the Secret Committee is obligated to fully consider the peaks, which dictate allowance of the subject application.

Extensive new data since the Declaration that has been submitted to peer reviewed journals is provided to the Secret Committee. For a summary and references, see Section I of this Response.

Regarding Applicant's presentations at scientific meetings, contrary to the Secret Committee's assertions, each presentation was independent and was very scientifically sophisticated requiring a significant effort on the part of each individual Ph.D. scientist to prepare and present. It was irreverent whether multiple presentations were given at any particular scientific meeting or whether they all occurred at separate meetings. Furthermore, poster presentations are significant. Applicant and the 11 BlackLight Ph.D.'s have made 27 oral or poster presentations with more in progress. Tremendous effort and care went into these presentations.

Applicant gave two oral presentations and a poster presentation at the Fall 2001 National Meeting of the American Chemical Society:

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[239] Reference 21.

1. R. Mills, "Novel catalytic reaction of hydrogen as a potential new energy source", Division of Industrial and Engineering Chemistry; Session: Industrial Bio-Based Technology, 222nd American Chemical Society Fall National Meeting, (August 26–30, 2001), Chicago, IL.

2. R. Mills, "Spectroscopic identification of a novel catalytic reaction of hydrogen", Division of Inorganic Chemistry; Session: Catalysis, 222nd American Chemical Society Fall National Meeting, (August 26–30, 2001), Chicago, IL.

3. R. Mills, "Spectroscopic identification of a novel catalytic reaction of hydrogen", Division of Physical Chemistry; Session: Physical Chemistry Poster Session, 222nd American Chemical Society Fall National Meeting, (August 26–30, 2001), Chicago, IL.

DR. RAY GAVE AN ORAL PRESENTATION AT THE RECENT 54TH ANNUAL GASEOUS ELECTRONICS CONFERENCE OF THE AMERICAN PHYSICAL SOCIETY MEETING:

P. Ray, R. Mills, "Spectroscopic identification of a novel catalytic reaction of hydrogen plasma", Session ET1: Lighting, American Physical Society Meeting, 54th Annual Gaseous Electronics Conference, October 9–12, 2001, Pennsylvania State University, State College, PA.

Dr. Dayalan will present an invited talk at the Long Beach Annual Battery Conference 2002, January 15–18, 2002, California State University at Long Beach, CA:

R. L. Mills, E. Dayalan, "Novel Alkali and Alkaline Earth Hydrides for High Voltage and High Energy Density Batteries", Proceedings of the 17th Annual Battery Conference on Applications and Advances, California State University, Long Beach, CA, (January 15-18, 2002), in press.

Applicant will be speaking about his lower-energy hydrogen technology at the following six upcoming National American Chemical Society Meetings:

1. R. L. Mills, J. Dong, J. He, B. Dhandapani, W. Good, A. Voigt, S. Hicks, M. Nansteel, E. Dayalan, P. Chandra, "Spectroscopic Identification of a Novel Catalytic Reaction of Hydrogen", Division of Inorganic Chemistry, Oral Presentation, 223rd ACS National Meeting, (April 7–11, 2002), Orlando, FL.

2. R. L. Mills, J. Dong, J. He, B. Dhandapani, W. Good, A. Voigt, S. Hicks, M. Nansteel, E. Dayalan, P. Chandra, "Novel Catalytic Reaction of Hydrogen as a Potential New Energy Source", Division of Inorganic Chemistry, Oral Presentation, 223rd ACS National Meeting, (April 7–11, 2002), Orlando, FL.

3. R. L. Mills, J. Dong, J. He, B. Dhandapani, W. Good, A. Voigt, S. Hicks, M. Nansteel, E. Dayalan, P. Chandra, "Novel Catalytic Reaction of Hydrogen as a Potential New Energy Source", Division of Industrial and Engineering Chemistry, Oral Presentation, 223rd ACS National Meeting, (April 7–11, 2002), Orlando, FL.

4. R. L. Mills, J. Dong, J. He, B. Dhandapani, W. Good, A. Voigt, S. Hicks, M. Nansteel, E. Dayalan, P. Chandra, "Novel Catalytic Reaction of Hydrogen as a Potential New Energy Source", Catalysis and Surface Science Secretariat, Oral Presentation, 223rd ACS National Meeting, (April 7–11, 2002), Orlando, FL.

5. R. L. Mills, J. Dong, J. He, B. Dhandapani, W. Good, A. Voigt, S. Hicks, M. Nansteel, E. Dayalan, P. Chandra, "Novel Catalytic Reaction of Hydrogen as a Potential New Energy Source", Division of Physical Chemistry, Poster Presentation, 223rd ACS National Meeting, (April 7–11, 2002), Orlando, FL.

6. R. L. Mills, J. Dong, J. He, B. Dhandapani, W. Good, A. Voigt, S. Hicks, M. Nansteel, E. Dayalan, P. Chandra, "Novel Catalytic Reaction of Hydrogen as a Potential New Energy Source", Division of Physical Chemistry, Sci-Mix Poster Presentation, 223rd ACS National Meeting, (April 7–11, 2002), Orlando, FL.

Applicant will also be presenting his lower-energy hydrogen technology at the following conferences:

7. R. M. Mayo, R. L. Mills, M. Nansteel, "Direct Plasmadynamic Conversion of Plasma Thermal Power from a Novel Plasma Source to Electricity for Microdistributed Power Applications", 40th Power Sources Conference, (June 6–13, 2002), Cherry Hill, NJ.

8. R. L. Mills, E. Dayalan, "Novel Alkali and Alkaline Earth Hydrides for High Voltage and High Energy Density Batteries", Proceedings of the 17th Annual Battery Conference on Applications and Advances, California State University, Long Beach, CA, (January 15-18, 2002), in press.

Applicant gave the following presentation on his theory:

R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Global Foundation, Inc. Orbis Scientiae entitled *The Role of Attractive and Repulsive Gravitational Forces in Cosmic Acceleration of Particles The Origin of the Cosmic Gamma Ray Bursts*, (29th Conference on High Energy Physics and Cosmology Since 1964) Dr. Behram N. Kursunoglu, Chairman, December 14-17, 2000, Lago Mar Resort, Fort Lauderdale, FL.

Applicant's talk was published in the proceedings of that meeting:

R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Global Foundation, Inc. Orbis Scientiae entitled *The Role of Attractive and Repulsive Gravitational Forces in Cosmic Acceleration of Particles The Origin of the Cosmic Gamma Ray Bursts*, (29th Conference on High Energy Physics and Cosmology Since 1964) Dr. Behram N. Kursunoglu, Chairman, December 14-17, 2000, Lago Mar Resort, Fort Lauderdale, FL, Kluwer Academic/Plenum Publishers, New York, pp. 243-258.

Applicant was invited to submit a paper based on this presentation at the National Hydrogen Association Meeting that was published in the proceedings of the meeting:

R. Mills, "BlackLight Power Technology-A New Clean Hydrogen Energy Source with the Potential for Direct Conversion to Electricity", Proceedings of the National Hydrogen Association, 12 th Annual U.S. Hydrogen Meeting and Exposition, *Hydrogen: The Common Thread*, The Washington Hilton and Towers, Washington DC, (March 6-8, 2001), pp. 671-697.

Applicant gave a presentation on Applicant's process, novel compounds, and power technologies which were published in the proceedings of the meeting:

R. Mills, "BlackLight Power Technology-A New Clean Energy Source with the Potential for Direct Conversion to Electricity", Global Foundation International Conference on "Global Warming and Energy Policy", Dr. Behram N. Kursunoglu, Chairman, Fort Lauderdale, FL, November 26-28, 2000, Kluwer Academic/Plenum Publishers, New York, pp. 1059-1096.

Applicant has gone far beyond that which would be deemed necessary to present his technology to the public. The Secret Committee has held Applicant to an UNCONVENTIONAL STANDARD.

Conclusion

As shown by the arguments given in this Response, quantum mechanics at best can be considered a tool to calculate results from experiments. And, it has no reliable predictive power; nor, does it exclude new discoveries that are consistent with first principles such as the present invention of lower-energy hydrogen any more than it precluded the existence of high temperate superconductors. Consideration of Applicant's invention should not be prejudiced by allegiances and interests in preserving quantum theory. It is to Applicant's credit that he has solved the atom more accurately and consistently than the model which is provided by quantum mechanics and that his theory is successful where quantum mechanics fails. Applicant has further met the Secret Committee's new standard of disproving conventional Quantum Theory, which does not represent physical reality. In contrast, Applicant's theory represents physical reality, has remarkable accuracy with theoretical predictions, and is internally consistent and in compliance with physical laws. But, more importantly, Applicant has now conclusively shown experimentally that lower-energy hydrogen exists with the same spectroscopy upon which quantum mechanics was initially based in it's infancy before its deviation from the physical world into other imaged dimensions and virtual particles. Our data must be treated with the same standard. In addition to spectroscopy, Applicant has confirmed these lower-energy states by an exhaustive array of other tests. Therefore, the patent should be issued.